Welding Engineer

PRICE 50 CENTS

JANUARY, 1959

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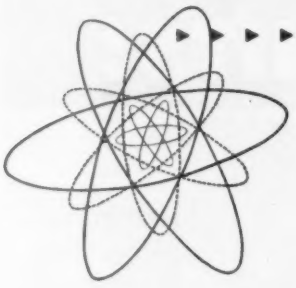
Vol. 44 — No. 1

Welding Engineer

The magazine of joining and severing materials

This is welding: January, 1959



A guide to nuclear power—II 31

This second article in a series of four by **W. D. Briggs** deals with nuclear reactors: types now in operation, fuels they use, and the manner in which they produce heat energy. Coupled with this installment is a second article, "Atomic Milestone", describing important welding steps in the fabrication of a complex stainless reactor vessel.

Kaiser plant welds legs for giant offshore tower 36

The largest welding job ever tackled by Kaiser Steel Corp.'s Napa, Calif., plant —fabrication of four 700-ton legs for the world's largest movable structure, exclusive of ships—is viewed in this start-to-finish treatment.

Producer gives instructions for welding moly 38

R. R. Freeman and **J. Z. Briggs** of Climax Molybdenum Co. present the informative results of a six-year investigation by universities and aircraft fabricators into the problems of welding molybdenum.

"Flexible automation" on refrigerator welding lines 42

Here's one way in which Norge Div. of Borg-Warner Corp. is meeting the challenge of refrigerator sales competition: with three new automated welding lines —each of which can economically produce four or more designs in several different sizes.

Typewriter parts are projection welded 44

. . . and because welding is used, those who purchase today's typewriters do so at a hefty saving: up to 145% less than the price that would have to be set if other parts joining methods are used.

Fire prevention and protection in welding and cutting operations 57

Lay the groundwork for fire safety in your plant by reading and posting Roger Cholin's "Nine rules of safety", plus his informative discussion of the proper steps to be taken in preventing disaster.

Also in this issue:

Swiss rail-welder in production at NCG 35
Loading crane vital cog in time-saving system 46
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Canadian welding school conducted by Price-Poole 49
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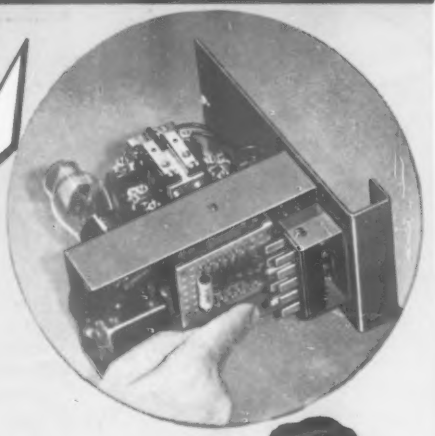
for Better Welding Production...

INDUSTRIAL *Plug-In* UNITS!

Welding Press Control illustrating simple removal of plug-in electronic timer



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are designed to stand up under hard industrial usage. Both timers and sequencing relays can be installed in a matter of seconds. Down time is reduced to absolute minimum during replacement. Timing circuits are fail-safe—if any tube fails to fire, circuit will be opened and welding process stopped instantly.

Plug-in relays being removed from welding press controller Faster electrical maintenance

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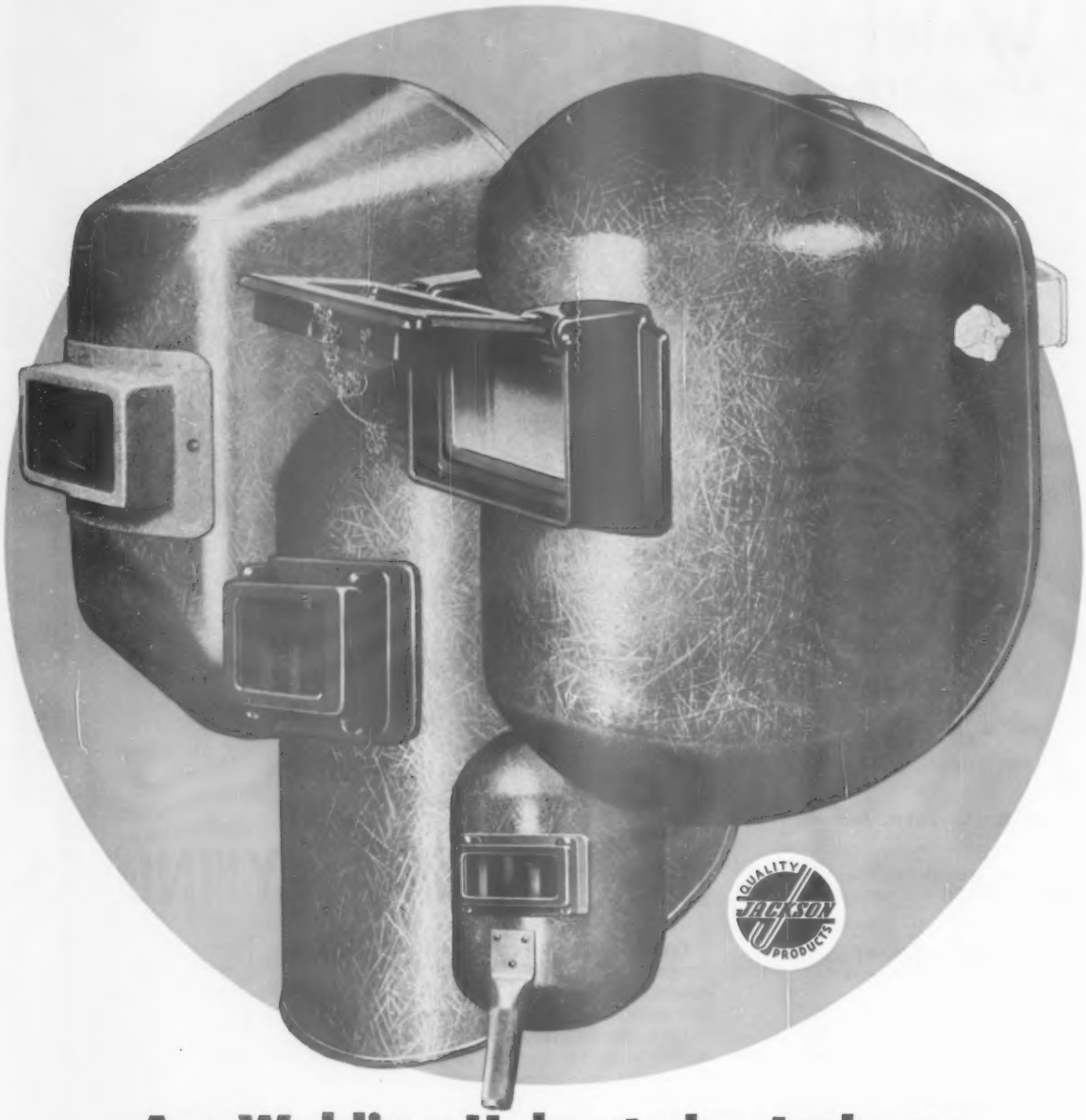

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NEWS

WESTINGHOUSE experimental ultrasonic seam welder has welded 0.010-in. aluminum continuously at a rate of 15 in. per minute.

Westinghouse develops experimental ultrasonic seam welder

Westinghouse Electric Corp., Pittsburgh, has developed an ultrasonic seam welder that can weld sheets of dissimilar metals continuously. Though still in the experimental stage, it has been determined that the welder brings to seam welding the advantages of ultrasonic welding—making dissimilar metals weldable and eliminating need for pre-welding surface preparation.

The experimental model has welded light silver foil to thick copper strap at a rate of 20 ipm, and two sheets of 0.010 aluminum continuously at a rate of 15 ipm.

Testing and research are continuing on the new instrument in an effort to increase welding speed and thickness of metals that can be welded.

In continuous ultrasonic welding the work pieces are passed between two wheels vibrating at 20 kc per second. The edges of the wheels press against the metals on opposite sides of the sheets. At point of contact, wheels break up the oxide coating on the metals' surface, and with a kneading action weld the metals' surface lattices to themselves.

The ultrasonic seam looks similar to an electric weld, but no electric current is passed through the spot being welded.

The centers of the vibrating wheels are attached to transducer assemblies which convert electrical energy to high-frequency vibrations. Each assembly consists of a magnetostrictive transducer, a coupling bar and an enclosure for water cooling.

Electrical power causes the transducer to vibrate longitudinally. Vibration is passed down the coupling bar to the wheel causing it to vibrate as a solid disc with free circumference. This causes the center of the wheel to be pulled in and out, resulting in flexural vibrations moving radially from the wheel's center to its edge.

MacGuffie heads new Airco department

Charles I. MacGuffie had been named to head Air Reduction Co.'s new Special Products Department. The new department, an expansion of the company's machine welding department, will make products available to industry that need specialized engineering assistance in their application.

MacGuffie

MacGuffie is former manager of marketing, welding department, General Electric Co. He is first vice president of the American Welding Society and past chairman of the National Electrical Manufacturers Association welding section.

J. H. Berryman, manager of the old department, is now general sales manager of the new department.

Coyne Cylinder builds West Coast plant

Coyne Cylinder Co. is putting the finishing touches on its new 44,000-sq-ft building located in the Lindenville Industrial Park section of south San Francisco. It will house complete acetylene cylinder manufacturing facilities, including automatic welding equipment, special design machinery, lathes and quality control laboratories. The new plant will enable Coyne to increase production of its recently developed "92" acetylene cylinder.

Chemetron acquires 3 Cardox divisions

Chemetron Corp., New York City, has acquired the carbon dioxide, chlorine dioxide and fire equipment divisions of Cardox Corp.

The carbon dioxide activities of Chemetron's National Cylinder Gas Div. will be combined with those of the new acquisition to form Cardox Div. of Chemetron. Roy T. Omundson, former president of Cardox, will head the division.

In addition to obtaining the assests of the three divisions, Chemetron also acquired the Cardox interests in the subsidiary Dean-Cardox, Witt Ice and General Carbonic companies. To close the deal Chemetron gave up 165,000 shares of common stock and $2,000,000 in cash.

Chemetron's marketing of carbon dioxide and dry ice has been extended to 14 additional states.

Arc welding booklet authorized at NEMA meet

Members at the recent Arc Welding Section of the National Electrical Manufacturers Association meeting, held in the Blackstone Hotel, Chicago, authorized printing of an educational arc welding booklet.

The booklet will be released early this year.

A Navy Department problem has been referred to the Federal Military Specifications Committee. The identifying color coating on low hydrogen electrodes is destroyed when electrodes are rebaked at naval facilities. The committee is to suggest solutions at its next meeting.

The committee was also told military specification MILE-19322 had been approved.

WILLIAM H. Haile, president of Linde Co., views liquid sample held by operator M. L. Frazier during inspection of major addition to Linde's Fontana, Calif., oxygen plant.

FRANK Woehr, left, principal of Aviation High School, L. I., N. Y., and Jack Bloom, welding instructor, examine one of 22 P&H a-c/d-c high frequency welders used by school to teach metal-arc, spot-gun and inert-gas techniques in aircraft fabrication. Machines were later enclosed in booths.

Linde president tours West Coast

William M. Haile, president of Linde Co., recently toured the company's West Coast facilities. The tour covered the on-site oxygen plant at Colorado Fuel & Iron Corp., Pueblo, the building site at Pittsburg, Calif., and the addition to the Fontana, Calif., oxygen plant.

The Pittsburg plant will produce 300 tons of oxygen and nitrogen daily, after completion in 1960. Norman Harris will be operating superintendent of the new plant.

Fischbach & Moore Inc., San Francisco, was recently awarded a contract for the electrical construction phase of the Pittsburg plant.

After the tour, Haile predicted the use of oxygen in steel making in the western states will double within the next five years. He cited the addition to the Fontana plant as an example of the increased use of oxygen in steel production.

Budd forms Bufra, French subsidiary

Budd Co., Philadelphia, has formed Bufra, a French subsidiary headquartering in Paris. The company will market in Western Europe a line of testing processes machines being developed by Tatnall Measuring Systems Co., another Budd subsidiary.

Raybestos-Manhattan has new western quarters

Raybestos-Manhattan Inc. has moved its San Francisco district warehouse and offices from 131 Mission St. to new and larger quarters at 168 Beacon St., in south San Francisco.

COMING EVENTS

JAN. 8-10, 1959: NOIMA Trade Show and Exhibit, Atlanta Biltmore Hotel, Atlanta, Ga.

JAN. 19-20: 46th Annual Meeting of Compressed Gas Association, Waldorf-Astoria Hotel, New York City.

JAN. 26-29: Plant Maintenance and Engineering Show, Cleveland Public Auditorium, Cleveland.

JAN. 28-29: Midwest Welding Conference, Illinois Institute of Technology, Chicago.

MARCH 9-10: IAA 1959 Convention, Roosevelt Hotel, New Orleans.

MARCH 12, 1959: NEMA Arc Welding Section Quarterly Meeting, Pittsburgh.

MARCH 16-20, 1959: ASM Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.

APRIL 7-10: 1959 AWS Welding Show International Amphitheater, Chicago, Ill.

APRIL 18-22: ASTE Annual Meeting, Schroeder Hotel, Milwaukee.

MAY 4-6: NWSA Annual Convention, Fairmount Hotel, San Francisco.

JUNE 4-5, 1959: NEMA Arc Welding Section Quarterly Meeting, Hot Springs, Va.

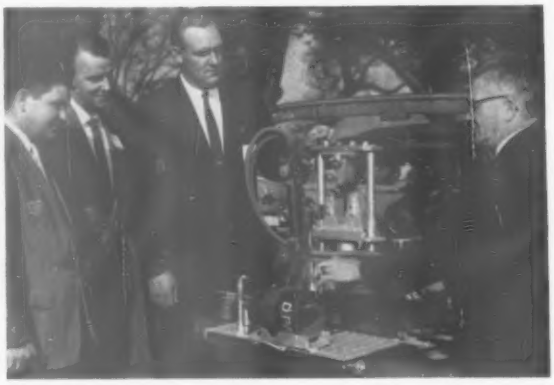
Midwest welding conference set for January 28 and 29

The chemistry building of the Illinois Institute of Technology, Chicago, will be the site of the Fifth Annual Midwest Welding Conference sponsored jointly by Armour Research Foundation of IIT and the Chicago American Welding Society section.

Current developments in welding—from ultrasonic welding to the practical aspects of welding in missile applications—will be discussed. The first day's papers include: "Factors

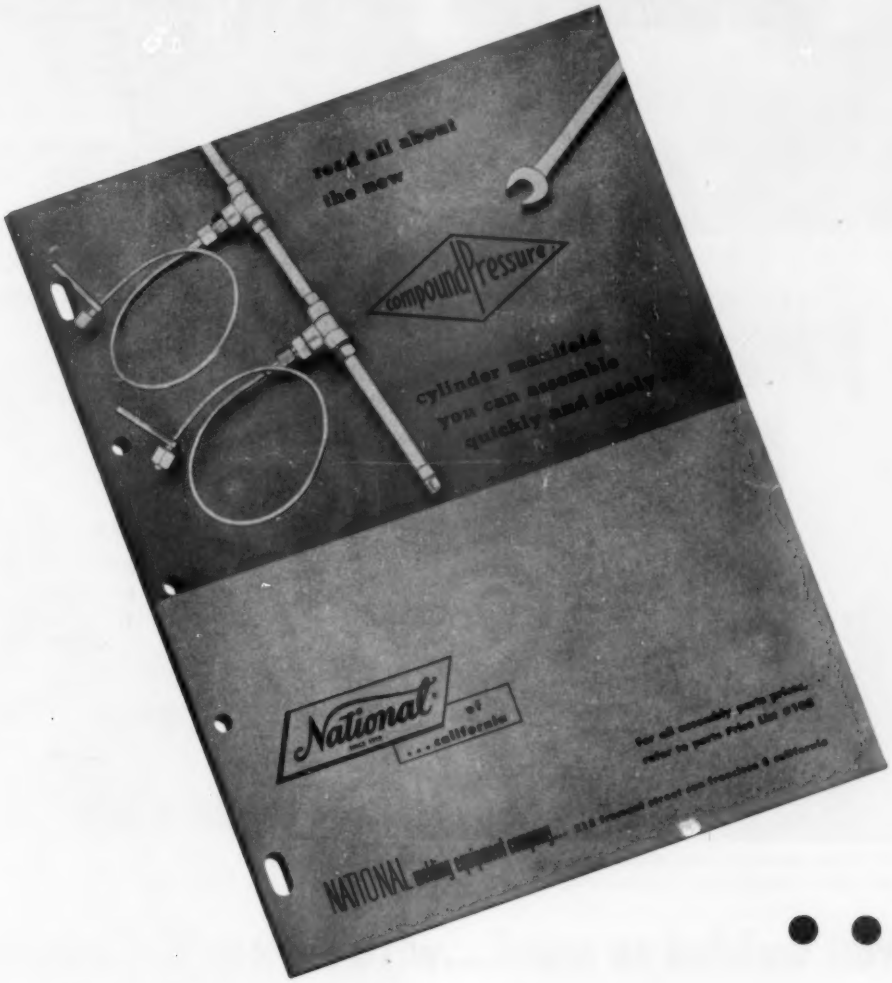
(Continued on page 75)

CERTIFICATE of award presented to E. J. Brady, president of Alloy Rods Co., York, Pa., for his company's Wear-O-Matic Wire Feed Unit. Process was entered in class for industrial processes and machines at 7th International Inventors Exhibition in Brussels held in conjunction with World's Fair. Unit, which uses continuous tubular wire electrodes, is for semiautomatic hardfacing.



WILLIAM Lilly, welding supervisor, Certified Pipe Welding Bureau, Chicago, brought his traveling welding laboratory to the University of Wisconsin Extension Division's recent institute on "Pressure-pipe and pressure-vessel welding codes and certification." Watching demonstration are, left to right, Alex Falch, Art Kujak and Jack Hesselman.

24 Pages *of interesting data on cylinder manifolds* • • •



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This 24 page catalog (our Form 14) offers a beautifully illustrated description of the COMPOUND PRESSURE cylinder manifold for industrial and medical cylinder gases. There are no solder joints, and the entire cylinder manifold may be assembled or disassembled with the use of two open-end wrenches. All assembly parts can be carried in stock and the parts are so designed that they permit prompt assembly of cylinder manifolds of every useful capacity; "wall type, stand type with center sections for one or more regulators, for manual or automatic changeover." The COMPOUND PRESSURE cylinder manifold is the sturdiest, the safest and the most attractive one your money can buy, and its price is very little more than that of ordinary manifolds. If you are interested in cylinder manifolds,

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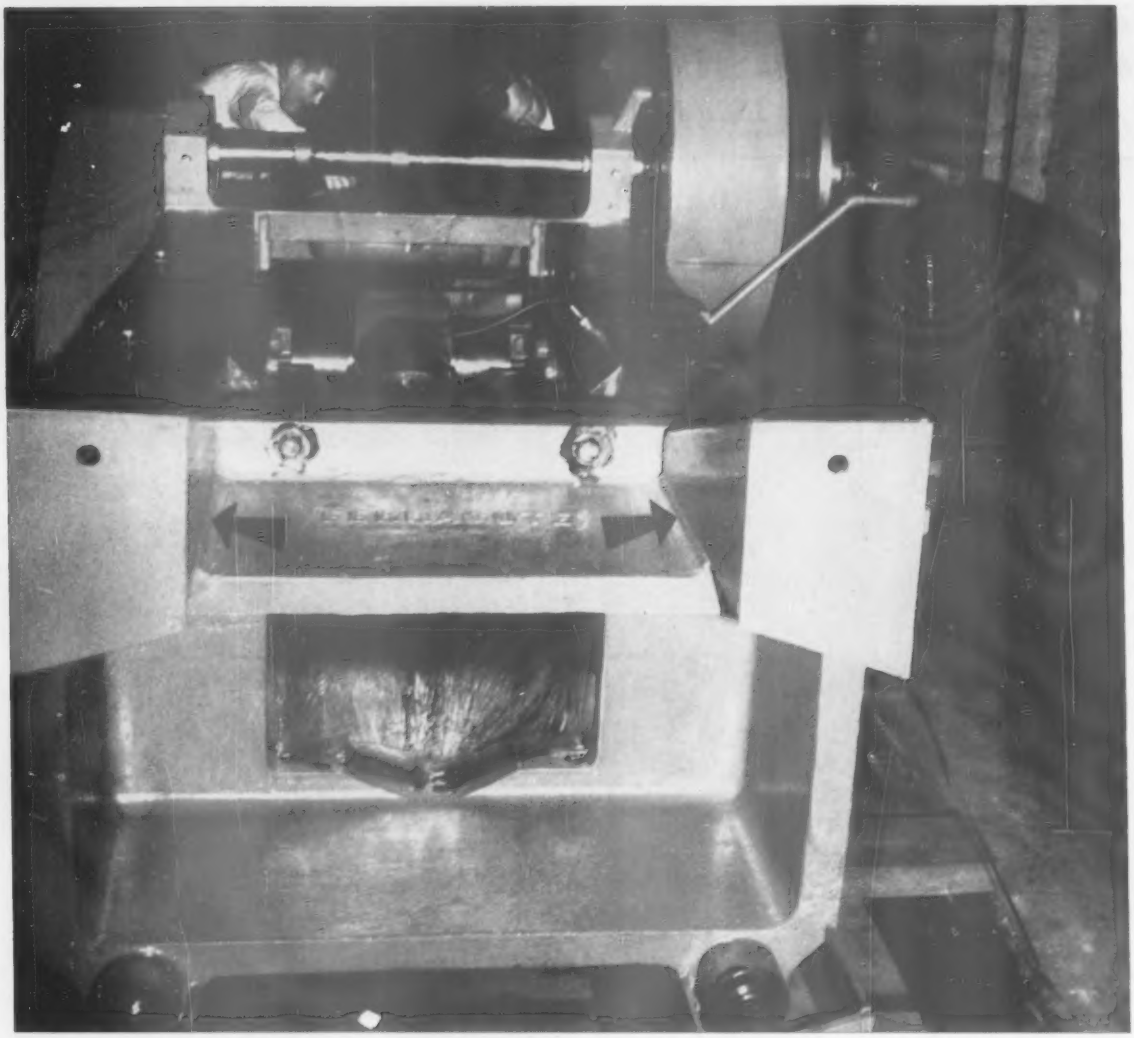

On its side, this 325 ton stamping press shows where fabricated steel legs are welded to the ductile iron base with Ni-Rod "55". Using ductile iron in head and bed, designer was able to drop press height two feet, and cut dead weight considerably.

Ductile iron welded to steel...with Ni-Rod "55" electrode ...supports 325 tons under impact

The bed of this stamping press is ductile iron. The legs are fabricated steel plate.

Weldors at the Ferracute Machine Company join these sections easily with Ni-Rod "55"* electrodes. Get a weld strong enough to support the entire weight of the press—325 tons—under impact!

They also use Ni-Rod "55" for head members—welding ductile iron to cast iron. Here again—excellent results. The high nickel content of this electrode fuses well with cast iron... builds up a sound, crack-free deposit. What's more, the weld area is soft enough for easy machining.

Inco booklet gives helpful tips on welding cast iron

"A Handy Guide To Welding Cast Iron" covers the use of Ni-Rod "55" and Ni-Rod* for emergency repairs, production work, salvaging castings, repairing heavy sections and joining dissimilar ferrous metals. Booklet also gives complete technical data and tips on preparation. For your copy write:

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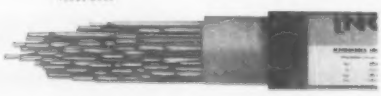
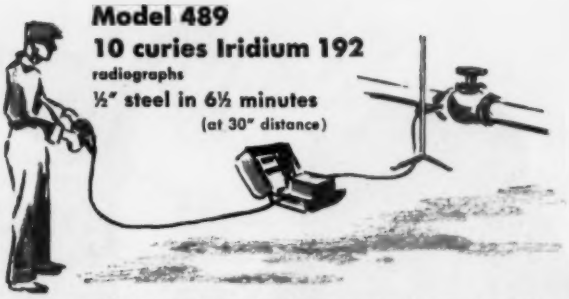


new roving units for "on-the-job" isotope radiography

at Electric Boat Div. General Dynamics Corp.



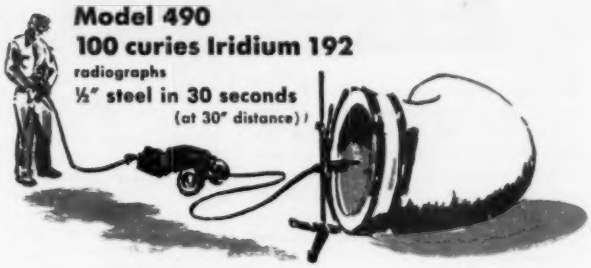
Model 489
10 curies Iridium 192
radiographs
½" steel in 6½ minutes
(at 30" distance)

Into a sturdy lightweight fiberglass case no bigger than an overnight bag Tech/Ops has compacted a ready-to-go radiography unit. Complete with a 15 foot control cable and a 14 foot source-guide cable it weighs only 58 lbs.

Its 10 curie Iridium 192 source (5.5 RHM output) will easily radiograph steel sections up to 2" thick in realistic exposure times. Great for pipeline work—it will take the full girth weld of an 8" diameter 1" thick steel pipe in four minutes. Great for radiography in tight spots—the whole works will pass through any opening a man can get through and the snout and guide cable will poke through a 1½" hole.

All this for only $1575.00 complete (without source).

P.S. It will also handle a 50 curie Thulium 170 source if you're inspecting light metals.



Model 490
100 curies Iridium 192
radiographs
½" steel in 30 seconds
(at 30" distance)

Here's a mobile powerhouse—a free wheeling isotope radiography unit that can easily handle the heavy stuff. 100 curies of Iridium 192 (55 RHM output) will radiograph, in one shot, the full girth weld of a 1½" thick steel pipe eight feet in diameter in 6½ minutes.

For all its power the unit is surprisingly lightweight—only 135 lbs. (it has an all-aluminum carriage). Rutty plant yards hold no terrors for the big balloon tires on which it rides. A 25 foot control cable and a 21 foot source-guide cable are carried on a front-mounted reel—pay out easily on the job, coil up smoothly for transport to the next one.

All this for only $2300.00 complete (without source).

For details on these units or any of the other machines or services listed below call any Picker Branch Office (see local 'phone book) or write Picker X-Ray Corp, 25 So. Broadway, White Plains, N.Y.

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one stop for everything in industrial radiography

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Two complete reference manuals for low-temperature silver brazing and fluxing are available upon request. Send for either one or both. ★ ★ ★ ★ ★ ★ ★

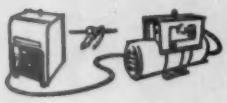
JANUARY
1959

Your

WeldWorld

at press time

Last minute news of interest to those engaged in joining and severing materials.



. . Now it's explosive welding . . . an aftermath of explosive forming. Several fabricators have used explosives to join similar and dissimilar metals, especially aluminum and stainless steels. Both fusion and non-fusion welding are possible.

. . High-chrome (12%) alloy, Carpenter 404, is highly weldable without any prior or post heat treatment. Developer is Carpenter Steel Co., Reading, Pa.

. . Upturn is due in welding industry, but like most of metal-working, it won't be spectacular.

. . Watch for special grinder for pipeline use said to be suitable not only for smoothing flame-cut bevels, but also for grinding true lands on beveled edges.

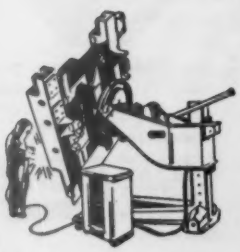
. . Will newly developed "magnetic girdle" welder change field pipeline welding from art to reproducible scientific process? Inventor claims 12-in. line joint can be completely welded in six minutes. Multipass welds can be made . . . all are downhill.

. . S. Morgan Smith Co., York, Pa., will be acquired by Allis-Chalmers Mfg. Co., Milwaukee, in merger calling for exchange of former's assets for A-C common stock.

. . Tungsten filament quartz lamps are used as heat source in new brazing technique for honeycomb. Developed by Armour Research Foundation, Chicago, for Air Force, system is applicable to all metals. Brazing cycle is matter of minutes . . . and speed is especially important in joining titanium.

. . Nickel consumption in free world was down about 20% in 1958, but Inco says abundant supplies will spur vigorous competition for new markets in 1959. Another target: markets lost when nickel supplies were being stockpiled by the government and channeled to defense work.

. . Industry talk indicates a price change in electrodes . . . but difference of opinion exists as to which direction change will take.



How to be **LIGHT-HEADED** *...but sane,* **SAFE** *and* **SOUND!**

No. 4672-A-2Q, with "fixed" steel Glassholder. (#4676-A-2Q has Dowmetal "lift-front" Glassholder).

LIGHTEST SAFETY BUY

this FIBRE-METAL *combination is lighter by...* **7** *ounces*

weighs much less than any other helmet-safety cap combo!

with QUICK-LOK

(Helmet also sold *separately* with exclusive F-M Headgear and with steel or plastic "fixed", or plastic or Dowmetal "lift-front" Glassholders.)

NEW #4672
"Combination"
WELDING HELMET SHELL
3 oz. LIGHTER

with QUICK-LOK

(*SuperLite* Cap has exclusive Polyethylene Suspension. Also sold *separately*, as #A-2.)

NEW #A-2Q
"SuperLite"®
ALUMINUM SAFETY CAP
4 oz. LIGHTER

HERE IS *THE* pair to pick... either as a combination or as separates! The NEW #4672 Weld Helmet "shell" is of Fiberglas-reinforced polyester resin... *narrow*, for close-quarter work and *deep* for full protection! It's self-extinguishing, non-warping. *And 3 ounces lighter than any standard helmet!* • Fitted with *QUICK-LOK* Attachment to the extremely light *SuperLite* Aluminum Safety Cap, the "combination" is incomparably air-light... for easy, all-day comfort. • *Famous Features:* C-1 Polyethylene Suspension, girder-ribbed cap safety design, quick and positive connect-disconnect. • ***Ask your Welding & Safety Supply Distributor for Fibre-Metal's "light combination" TODAY!***

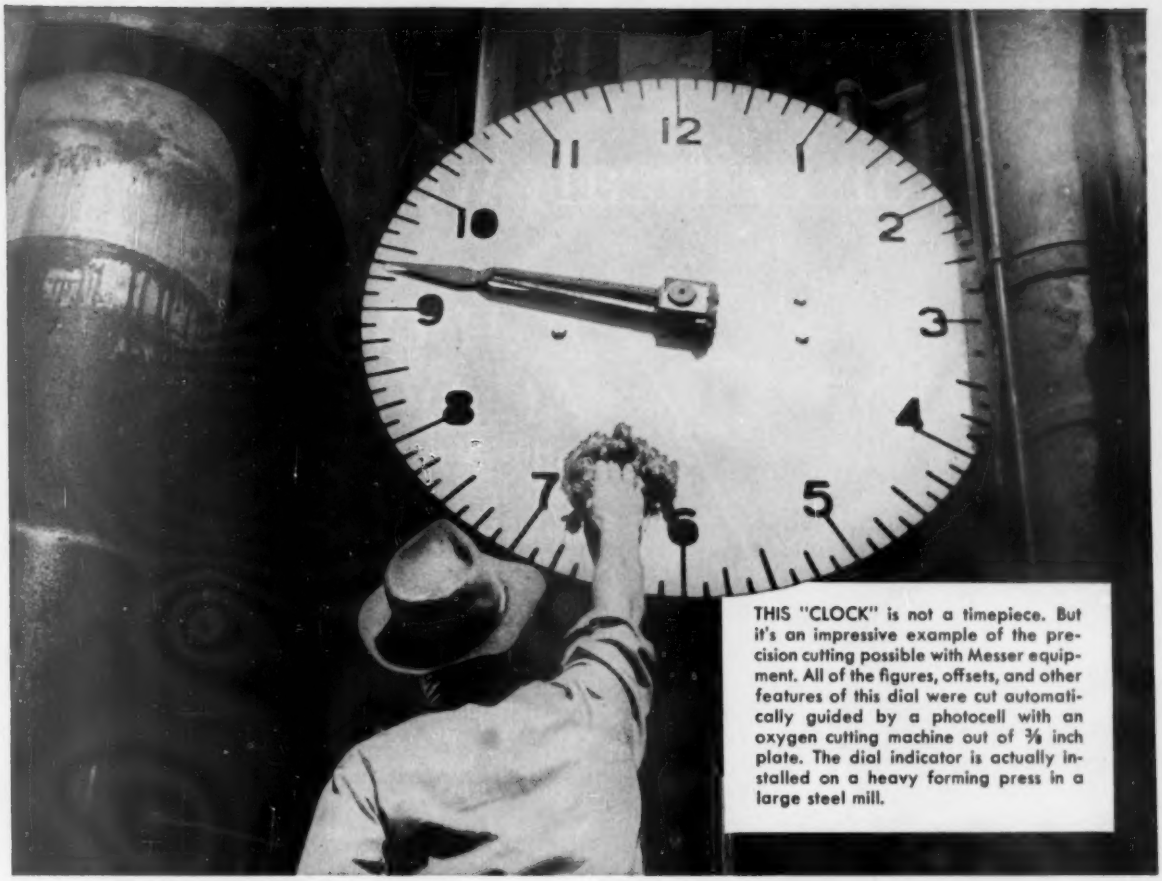
No. 676-3-C has #1096 Dowmetal "lift-front" Glassholder.

Famous #4-C Headgear has ratchet head-size adjustment, is free-floating.

Sold everywhere! Form "T" describes it. Just ask!

THE FIBRE-METAL PRODUCTS COMPANY

CHESTER, PENNSYLVANIA • ***In Canada: Fibre-Metal (Canada) Limited, Toronto***



THIS "CLOCK" is not a timepiece. But it's an impressive example of the precision cutting possible with Messer equipment. All of the figures, offsets, and other features of this dial were cut automatically guided by a photocell with an oxygen cutting machine out of ⅜ inch plate. The dial indicator is actually installed on a heavy forming press in a large steel mill.

Around the clock...

MESSER CUTTING MACHINES PERFORM NEW MIRACLES IN AUTOMATIC PRECISION CUTTING

Isn't it "time" you thought about the money-saving advantages you can get through the use of the new and revolutionary cutting techniques now possible with *Messer Cutting Machines?*

INCREASE YOUR PROFITS

Experience has shown that the Messer cutting machine versatility of design permits greater shop flexibility and the increased use of automation. The result? Lower costs, lower waste, GREATER PROFITS.

This unique oxygen cutting equipment features a completely engineered system of operation. This leads to new high standards in precision workmanship and greater accuracy.

ASK US FOR MORE DETAILS!

In steel mills, in shipyards—wherever cutting machines are used—Messer equipment can increase efficiency. It will pay you to find out now what Messer can offer you. Write us for full information. No obligation, of course. Messer Cutting Machines, Inc., Chrysler Building, 405 Lexington Avenue, New York 17, N.Y.

Messer Cutting Machines

WELDING ENGINEERING SINCE 1898

for critical welding

P&H Combination AC-DC Welders

with ON-OFF automatic high frequency

These dual-purpose welders are ideal for super-critical welding because they offer you:

- pre-set gas and water timing
- foot-operated remote heat adjustment and primary contactor control
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Milwaukee 46, Wisconsin

HANDY ALLOY DATA SHEET

HANDY & HARMAN
ENGINEERING DEPARTMENT
82 FULTON STREET, NEW YORK 38, N. Y.

ALLOY LIST

Handy & Harman Silver Brazing Alloys

...The COMPLETE line that meets all specifications and production needs

Need to join any combinations of metals—ferrous and nonferrous? Investigate the vast number of products, assemblies and parts that are being joined better by silver brazing alloys. Handy & Harman, the Number One Source of, and Authority On Brazing Alloys and Methods makes—and makes readily available—the following silver brazing alloys:

HANDY & HARMAN SILVER BRAZING ALLOYS

NAME		SILVER	COPPER	ZINC	OTHER	MELTING POINT °F	FLOW POINT °F	TROY OUNCES PER CU. IN.
EASY-FLO		50%	15½%	16½%	(18% Cd.)	1160	1175	5.00
EASY-FLO #3		50	15½	15½	(16% Cd. 3% Ni.)	1170	1270	5.00
EASY-FLO 45		45	15	16	(24% Cd.)	1125	1145	4.92
EASY-FLO 35		35	26	21	(18% Cd.)	1125	1295	4.90
SIL-FOS		15	80	—	(5% P.)	1185	1300	4.45
SIL-FOS 5		5	88.75	—	(6.25% P.)	1185	1300	4.37
NEW NAME	**FORMER NAME**	**SILVER**	**COPPER**	**ZINC**		**MELTING POINT °F**	**FLOW POINT °F**	**TROY OUNCES PER CU. IN.**
BRAZE TEC*	TEC*	5	—	—	(95% Cd.)	640	740	4.60
" 056*	TEC-Z*	5	—	16.6	(78.4% Cd.)	480	600	4.53
" 071	SN #7	7	85	—	(8% Sn.)	1225	1805	4.82
" TL	TL	9	53	38		1410	1565	4.50
" 202	AT SPECIAL	20	45	35		1315	1500	4.68
" ATT	ATT	20	45	30	(5% Cd.)	1140	1500	4.64
" NE	NE	25	52½	22½		1250	1575	4.71
" 251	AE	25	57.5	17.5		1255	1625	4.68
" SS	SS	40	30	28	(2% Ni.)	1220	1435	4.76
" 404	SS-5	40	30	25	(5% Ni.)	1220	1580	4.72
" DT	DT	40	36	24		1235	1415	4.80
" DE	DE	45	30	25		1230	1370	4.82
" ETX	ETX	50	34	16		1250	1425	4.99
" 541	ALLOY-4772	54	40	5	(1% Ni.)	1340	1575	5.06
" 560	ER	56	22	17	(5% Sn.)	1145	1205	5.00
" 580	EB	57.5	32.5	—	(3% Mn.- 7% Sn.)	1120	1345	5.05
" RT	RT	60	25	15		1245	1325	5.02
" 603	RT-SN	60	30	—	(10% Sn.)	1115	1325	5.23
" 630	RSNI	63	28.5	—	(6% Sn.- 2.5% Ni.)	1275	1475	5.12
" EASY	EASY	65	20	15		1235	1325	5.06
" MEDIUM	MEDIUM	70	20	10		1275	1360	5.14
" BT	BT	72	28	—		1435	1435	5.24
" HARD	HARD	75	22	3		1365	1450	5.28
" 752	TR #1	75	—	25		1300	1330	5.06
" IT	IT	80	16	4		1345	1490	5.29
" 852	85 Ag.-15 Mn.	85	—	—	(15% Mn.)	1760	1780	5.08

*A Solder—Not a Brazing Alloy

Space does not permit listing the many special alloys, formulated for a particular or unique application. Handy & Harman Brazing Engineers and Technical Service are always ready to work closely with you on metal-joining problems and methods.

Comprehensive technical literature covering all aspects of brazing methods and alloys awaits your request.

GET THE FACTS FROM BULLETIN 20

This informative booklet gives a good picture of silver brazing and its benefits...includes details on alloys, heating methods, joint design and production techniques. Write for your copy.

Your NO. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

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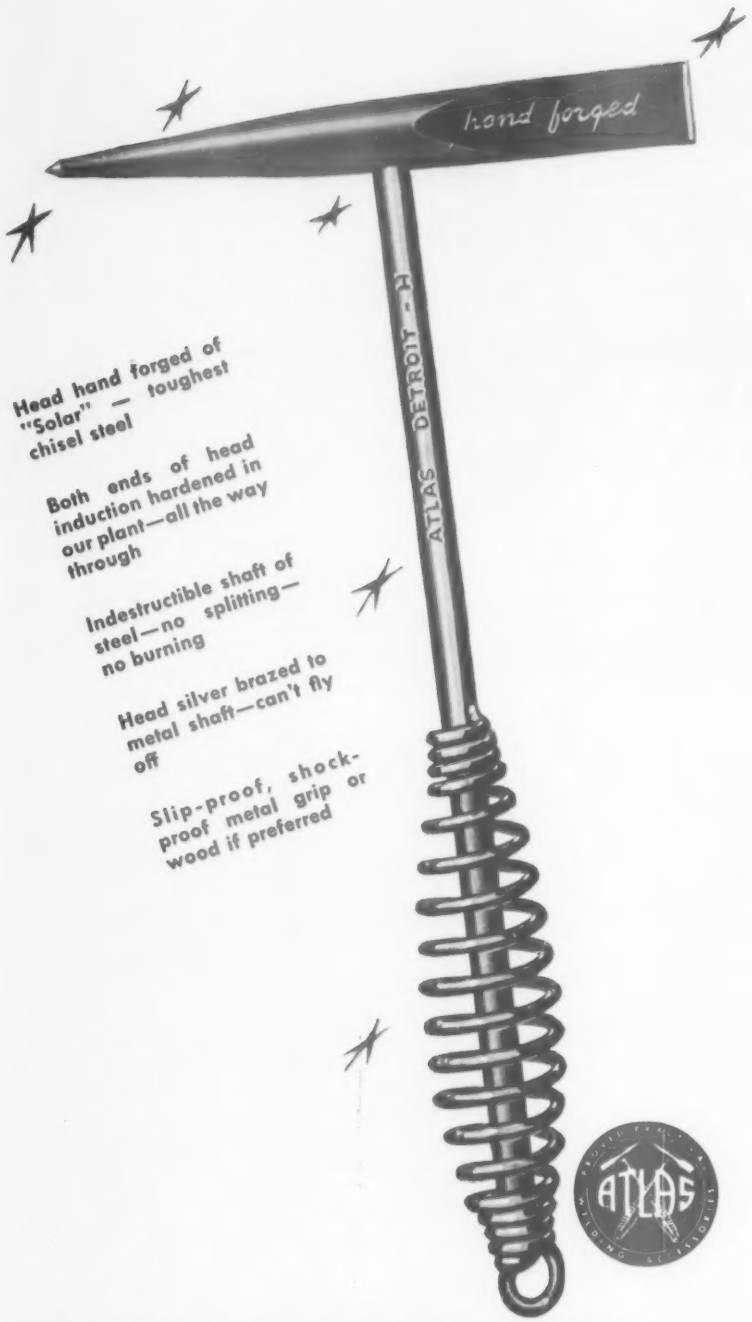
Head hand forged of "Solar" — toughest chisel steel
Both ends of head induction hardened in our plant—all the way through
Indestructible shaft of steel—no splitting—no burning
Head silver brazed to metal shaft—can't fly off
Slip-proof, shock-proof metal grip or wood if preferred
Hand forged
ATLAS DETROIT - H
ATLAS

ATLAS LEADS IN TOMAHAWK DESIGN
WATCH FOR ANNOUNCEMENT OF "W– B–"

You can't beat Atlas tomahawks for quality! Ask your welding supply dealer to show you the Atlas line of weld cleaning tools. Whatever the nature of your job there's an Atlas tool designed for it. Welders like them, their balance and feel and get better production with them.

ATLAS WELDING ACCESSORIES INC.
707 E. LEWISTON AVENUE, FERNDALE 20 (DETROIT) MICH.

Letters . . .

Letters should be addressed to: The Editor, WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill. No letter will be published unless signed, but your name will be withheld if requested.

Cleaning solvents

Sir: *Chicago*

In the November issue of the *WELDING ENGINEER* you answered questions concerning the dangers of using carbon tetrachloride as a cleaning solvent during welding (*Welding Clinic*, p. 60). Some solvents were mentioned in the article which might be used instead of carbon tetrachloride for cleaning gasoline oil tanks and for other cleaning purposes.

Some of the chemicals suggested were sodium silicate or trisodium phosphate dissolved in water.

Trisodium phosphate . . . will attack aluminum. There are many chemicals or other compounds which might be used to clean tanks and other materials for welding. Four suggested proprietory materials suitable for cleaning aluminum tanks are Diversey No. 36 or No. 909, Diversey Corp.; Alkalume AC No. 1, Northwest Chemical Co.; Oakite 80A, Oakite Products, and Turco 4215 or Aviation, Turco Products.

Howard E. Adkins
Kaiser Aluminum & Chemical Sales Inc.

Welding education

Sir: *North Dakota*

Your editorial in the November issue, as always, is excellent and again proves how familiar you are with the educational side of welding. . .

Adding new courses to the already crowded engineering schedule is not easy. We certainly need information about the latest proven welding processes to help us select proper courses. After all, we want our students to be the best informed engineers there are when they are graduated.

We would appreciate it if the welding industry could suggest a number of research projects we could offer to our graduate students, thus stimulating our growing graduate program. . .

I'm looking forward to hearing from the welding industry.

John H. Forrer
N. Dakota State College

Thank you

Sir: *Glenwood Springs, Colo.*

Thank you for the many years of service. I knew many of the pioneers of welding in the early twenties, and

WORLD'S FINEST DC WELDERS

miller

MODEL
SRH

Only 30¼" high, the new Gold Star SRH combines compactness with the sensational improvements introduced by the Miller Gold Star line. These include wholly new transformers, completely sealed semimetallic rectifiers and weld stabilized circuits. Where stacking or paralleling adaptability plus the finest dc performance ever achieved is indicated, the Gold Star SRH is the unequaled answer. Available in three models with 60% duty cycle ratings of 200, 300 and 400 amperes.

MODEL
SR

GOLD STAR DC-SR

The best welding current **ever** produced is delivered here. You **get** maximum arc stability for sounder, denser welds with **all** electrodes in **all** positions. And you get more of them in less time! This revolutionary performance coming from a machine of record-breaking dependability (see January welding magazines), has led industry and individuals to say of the Miller Gold Star SR-DC: "The SR gives **perfect** dc welding current; Easiest arc starting — bar none; Smoothest arc I ever used, and quiet to boot."

Available in both duplex and single models with ampere range from 200 to 1200. Complete complement of control equipment gives the Gold Star SR unlimited flexibility, plus milestone performance and unmatched dependability.

miller Electric Manufacturing Company, Inc. APPLETON, WISCONSIN

EXPORT OFFICE: 250 East 57th St., New York 19, N.Y. • Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

The wear of construction equipment parts is one of the highest cost factors of contractor operations. Only careful inspection and regular systemized maintenance can hold this cost down.

To promote regular inspection of equipment parts, Ranite offers at no cost or obligation their new Ran-Check-Charts and Stickers for systemized preventive maintenance. They provide an easy way for periodic checking of all non-lubed part surfaces so as to prevent "wear beyond repair" conditions.

For maximum wear-life Ranite's seven types of Job-Graded, Color-Coded hardsurfacing rods have been formulated to meet all wear conditions whether caused by abrasion, impact or a combination of both forces. Smooth running, all position, rapid deposition Ranite rods cover more area per pound making it most economical to use.

Get your *free* Ran-Check-Charts and Stickers from your local Ranite distributor or write direct *today*.

RANKIN MANUFACTURING CO.
616 S. Marengo Ave., P. O. Box No. 631, Alhambra, Calif.

Ranite
HARDSURFACING RODS

their knowledge, plus the *WELDING ENGINEER* helped me in many of my achievements . . . My biggest, I believe, was instigating construction of a giant size combination normalizing and annealing furnace for jet engine parts. A superior grain structure facilitated output and improved the product by eliminating many draws and anneals.

Keep up the good work by helping those that follow . . . so they can keep America on top.

O. J. Arness

Columbia, again

Sir: *Pittsburgh*

We were surprised to learn from the letter written by Roger L. Putnam, Jr., executive vice president, Package Machinery Co. (October, p. 16), that the information contained in our news release concerning the *Columbia*'s mast was incorrect.

The release was written from information supplied by Fuller Brush Co. Machine Division and was approved by that company prior to being mailed to your magazine. No mention of Package Machinery Co. was made to us and we had no way of knowing of their part in fabricating the mast.

Just as Package Machinery Co. takes pride in their work, we take pride in our record of issuing releases containing reliable information. We therefore are doubly sorry for any inconvenience we may have caused Package Machinery Co.

William K. Kinner
Aluminum Co. of America

Copies wanted

Sir: *Milwaukee*

Your article, "The meaning of weldability" appearing in the Mid-June 1958, Fact File issue was received with much interest.

We certainly would appreciate a reprint of this article.

Robert E. Maersch
Ampco Metal, Inc.
Chief Metallurgist

(Editor's note—So far more than 1,000 copies of this reprint have been sent to readers. Individual copies are still available without cost, but there is a slight charge for quantities of 5 or more.)

Remember April

Last year it was *Remember September*, but in 1959, National Welded Products Month will be a "Week." It is scheduled for the week of April 5, to coincide with the AWS Welding Show and Spring meeting, which this year will be in Chicago. Start plugging now.

NOW IN POP CANS

AIRCO'S POPULAR, LOW-COST EASYARC STAINLESS 308, 316 and 347

They end the moisture problem. Easyarc stainless steel electrodes are hermetically sealed moisture-free in extruded aluminum cans. You get them dry and store them dry. Break the seal and they are ready for use—oven fresh—without the need of costly drying equipment. Reseal the can and you keep any remainder virtually as originally packed.

Easyarc 308, 316, and 347 powdered metal electrodes for stainless give you approximately 90% more weld per rod than conventional s.s. electrodes—and they cost much less per pound.

In addition, restriking is instantaneous, arc action smooth, bead appearance exceptional, slag removal easy.

Order the new Easyarc 308, 316, and 347 stainless steel electrodes in the moisture-proof "POP" can from your nearest Authorized Airco Dealer.

Look for his name in the yellow pages of the telephone book under "Welding equipment and supplies." Or call your nearest Airco office.

AIRCO®

Offices and dealers in most principal cities

AIR REDUCTION SALES COMPANY

A division of Air Reduction Company, Incorporated
150 East 42nd Street, New York 17, N. Y.

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AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT • Products of the divisions of Air Reduction Company, Incorporated, include: AIRCO – Industrial gases, welding and cutting equipment • AIRCO CHEMICAL – vinyl acetate monomer, vinyl stearate, methyl butynol, methyl pentynol, and other acetylenic chemicals • PURECO–carbon dioxide–gaseous, welding grade CO_2, liquid, solid ("DRY-ICE") • OHIO–medical gases and hospital equipment • NATIONAL CARBIDE–pipeline acetylene and calcium carbide • COLTON–polyvinyl acetate, alcohols, and other synthetic resins.

MESSAGE #5

Welding Wire: Cost-saving

• Production men who are conscious of *both cost and quality* agree that a top-grade weld demands the *right* welding wire. *Only* by using wire with an analysis suited to the material to be welded can consistently sound welds—free from porosity and internal cracks—be produced. Use of the right wire means fewer rejects, less waste, lower costs—plus better performance of the finished part or product.

Experienced welding men have long found PAGE a most reliable source of welding wire for all their regular and special needs. The wide range of PAGE analyses—33 of them—makes it possible to select the exact wire that produces the kind of welds that lower production costs and increase profits.

PAGE experience, talents and facilities are available to you at all times. We have been exclusive wiremaking specialists for more than half a century, and are in an ideal position to furnish our customers with the right wire for each specific need. Furthermore, we have developed a broad packaging program which saves our customers time and money by supplying wire packaged to meet any requirement.

These factors, plus PAGE's nationwide set-up of conveniently-located distributors, backed up by nearby PAGE warehouse stocks, help make it economical and profitable for you to standardize on PAGE Welding Wire.

PAGE offers—
33 ANALYSES
...the right analysis for your welding job

There are *33 different analyses* in the PAGE line, covering the broadest range of applications: submerged arc...inert gas...tungsten or metal arc...oxy-acetylene gas welding...metal spraying.

For example— **ANALYSIS A-S-10**...A low carbon mild steel, Analysis A-S-10 is the "work-horse" of the PAGE line of bare (copper coated) welding wire. It is made from rimmed steel with closely controlled carbon, manganese, phosphorus and sulphur with only a trace of silicon. Its chief use is for submerged arc welding where with a neutral flux it will give a tensile of 55,000/60,000 p.s.i. with an elongation ranging up to 35%. The tensile can be raised by using flux containing carbon, manganese, or other strengthening alloys, or by using hard-facing fluxes a hardness of Rockwell C-35 to C-50 can be attained.

Because of its lack of deoxidizing agents (silicon, aluminum, etc.), it is not a suitable wire for high class CO_2 welding as it has a decided tendency towards porosity in the weld metal.

For example— **ANALYSIS A-S-15**...Our Analysis A-S-15 is an aluminum-killed mild steel wire with approximately 2% manganese with phosphorus, and sulphur held below .025%. Used with a neutral flux or inert gas, it shows appreciably higher tensile strength and as good an elongation as A-S-10. It gives a very clean deposit and is used where higher physical requirements warrant its higher cost. It will give a tensile strength of approximately 75,000 p.s.i. with an elongation of 40%.

For example— **ANALYSIS A-S-16**...This is the same analysis as A-S-15 with ½% molybdenum added. The molybdenum gives it additional tensile strength—up to 85,000 p.s.i. with neutral flux or inert gas—but reduces the tensile to about 20%. It is chiefly used for welding the carbon-molybdenum alloys (AISI-4012 to 4028 series) or wherever the importance of the higher tensile justifies its use. It will give a tensile strength of approximately 85,000 p.s.i. with an elongation of 20%.

NOTE: previous advertisements in this publication have included brief descriptions of PAGE Analyses A-S-8620, A-S-6150, A-S-30, A-S-NAX-9115, A-S-65, A-S-Armco Iron, A-S-6 and A-S-17. Detailed information on all 33 PAGE analyses is contained in our Welding Wire Comparison Chart DH-1218 shown below.

Write for—Welding Wire **Comparison Chart DH-1218** (*shown above*). This highly informative four-page chart lists detailed analyses of PAGE automatic welding wires, metal spray wires, bare electrodes and gas welding rods. Also shows uses and physical properties, including: tensile strength, elongation, Rockwell hardness. Chart lists virtually all competitive makes.

Write for—Submerged arc and inert gas welding wire **Folder DH-402A**...also gas welding rod **Booklet DH-1277.**

This message is for men who are vitally concerned with such welding problems as maintaining a smooth flow of production... preventing excessive rejects...and insuring trouble-free, economical, profitable operation.

and Profit Factors

PAGE offers— Packaging to meet your needs

PAGE Welding Wires are packaged in a wide variety of ways—for the most complete protection and the utmost convenience in handling, in stocking and in use. Here are some major types of PAGE packaging:

1. Paper Wrapped Coils 2. Coils in Cartons, Palletized
3. Bare Coils (packed in Leverpaks)
4. Masonite Reels 5. Payoffpaks 6. Payoffpallets
7. Gas Rods in Burlap-wrapped Bundles
8. Stainless Gas Rods in 10-lb. Tubes

For example— PAYOFFPAKS

Up to 700 lbs. of wire, without a single weld...coiled around a fiberboard cylinder within a fiberboard drum ...ready to be smoothly unreeled to the welding head for automatic or semi-automatic welding! Eliminates costly machine down-time for coil replacement. Payoff-paks come in three sizes: 20" diameter (holds 250 or 500 lbs.); 23" diameter (holds up to 700 lbs.).

Wrapped Coils— Coils in Cartons | Welding Wire in Coils | Handy Reels | Gas Rod Packing | Payoffpaks and Leverpaks | Payoffpallets

This Chart Shows How PAGE Offers The Exact Packaging You Want	Gas-shielded consumable electrodes		Filler wire for automatic or manual Inert Gas Welding	Submerged Arc Welding	Straight and cut lengths Bare wire	
PAGE WIRE for → / PACKAGING ↓	Automatic Welding	Semi-Automatic Welding			Manual Electric Welding	Oxy-acetylene Welding
25-lb. or 60-lb. coils wrapped in waterproof paper, steel-strapped, single or palletized.	✓	✓	✓	✓		
25-lb. or 60-lb. coils in individual cartons, single or palletized.	✓	✓	✓	✓		
120 or 180 lb. (22"/24" I.D.) coils, paper-and-burlap wrapped, or in cartons, palletized.	✓			✓		
Special coil sizes (on application).	✓	✓	✓	✓		
25-lb. reels (spools) in carton to fit all standard machines; single or palletized.	✓	✓	✓	✓		
Leverpaks, 15" dia., 25-lb. coils (12" I.D. x 2½" wide); Leverpaks, 17" dia. 50/60-lb. coils (12" I.D. x 4" wide).	✓	✓	✓	✓		
Payoffpaks: 20" dia. size holds up to 500 lbs., 23" dia. size holds up to 700 lbs.	✓	✓		✓		
Payoffpallets, holding 900-1200 lbs. of wire (1/16" to 1/8" sizes, incl.) coiled around pedestal on a wooden pallet.				✓		
Paper-and-burlap wrapped bundles, containing 50 lbs. of rods in 36" lengths.			✓			✓
Fibreboard cartons, containing 10 lbs. of rods in 36" lengths; single or boxed. 50¢ and over.			✓			✓
Burlap-wrapped 50-lb. bundles of bare wire electrodes in 14" and 18" lengths.			✓		✓	

Write for—PAGE Welding Wire Packaging Chart

This useful chart shows the many kinds of packaging of PAGE Welding Wires for each type of welding.

Now—about Delivery... PAGE offers— Availability from local stocks

• Here is a handy service that not only gets you the welding wire you need when you need it, but saves you money by making it unnecessary for you to tie up a sizeable investment in wire inventory.

You can get the exact PAGE automatic welding wire and welding rods your job requires direct from your nearby PAGE Distributor. Located at many points from coast to coast, PAGE distributors carry sizeable stocks for your convenience—and they are backed up by PAGE Warehouses at the strategic locations shown below. Close cooperation between PAGE distributors, PAGE warehouses and the PAGE mill is your guarantee of prompt, intelligent, individual service on your specific needs.

ACCO

Page Steel and Wire Division
AMERICAN CHAIN & CABLE

Monessen, Pa.*, Atlanta, Chicago*, Denver*, Detroit, Houston* Los Angeles*, New York, Philadelphia*, Portland, Ore. San Francisco*, Bridgeport, Conn.

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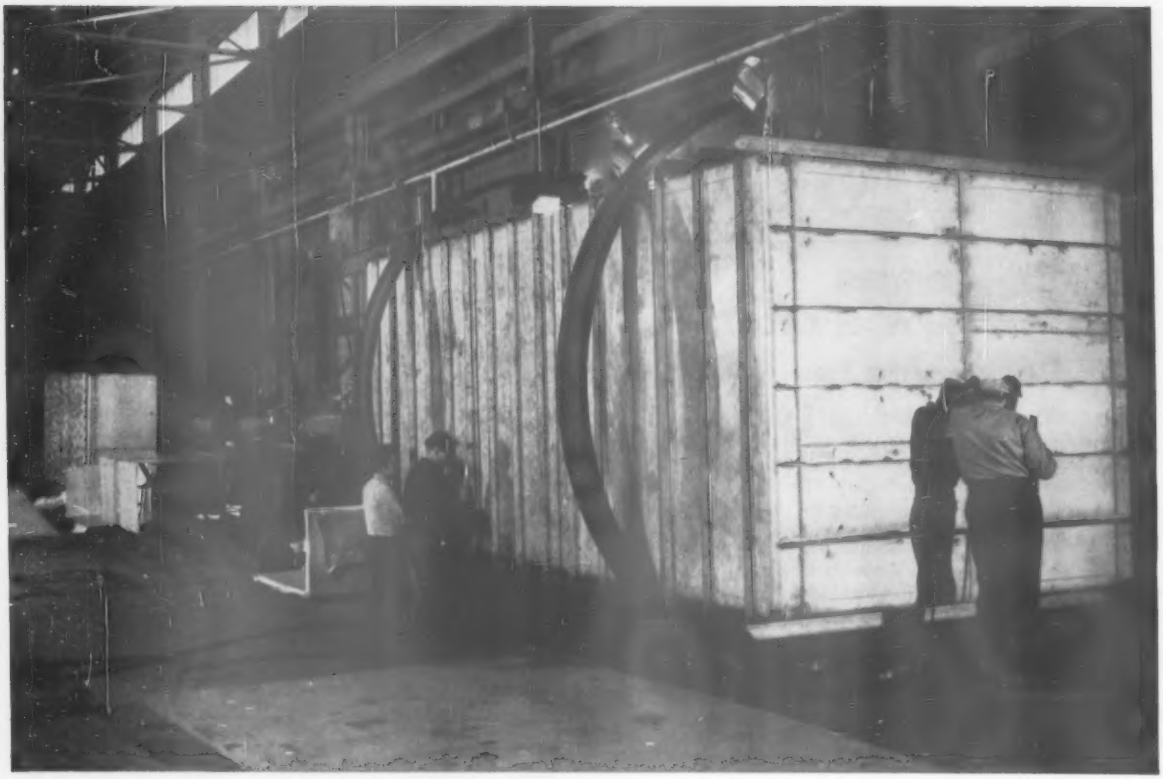

For Stainless Welds with Quality Plus . . .

CHICAGO STEEL TANK CO. specifies

ARCALOY STAINLESS STEEL ELECTRODES

The large tank illustrated above is one of several constructed by Chicago Steel Tank Co.,* Chicago, Ill., designers and fabricators of steel vessels. These vessels, which measured 8 feet wide, 9 feet high, and 20 feet long, were fabricated of type 304 stainless steel plate. The welding procedures employed were the responsibility of Henry Rouson, welding engineer, who selected Arcaloy type 308 AC-DC stainless steel electrodes for all of the manual welds.

Henry Rouson specified Arcaloy electrodes for this job, just as he has for many others. The requirements for quality at CST demand a little more than the usual high quality expected of a stainless steel electrode. Good appearance and uniformity of weld are considered extremely important.

* A Division of U. S. Industries, Inc.

Stainless steel or stainless clad material is used on critical applications for its corrosion resistance and high strength properties and the fabricator of these materials knows that electrode selection must be made with care to preserve these qualities. Alloy Rods Company has provided in Arcaloy stainless steel electrodes all of the necessary qualities for sound stainless welding, plus welding characteristics which have made this electrode a favorite of both welding management and their weldors.

There are 25 types of Arcaloy stainless steel electrodes in lime or AC-DC (titania) coatings that will improve your products . . . provide a better quality weld metal. Write for Bulletin AR-10-2 Alloy Rods Company, P. O. Box 1828, York, Pennsylvania.

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QUALITY WELDING ELECTRODES FOR
Stainless Steel
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NO FINER ELECTRODES MADE . . . ANYWHERE

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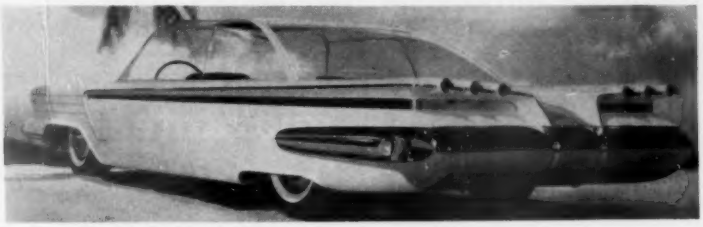


aluminum auto

Several industry spokesmen have in recent weeks predicted aluminum's continuing invasion of markets held by other materials. The automotive industry, already invaded in a small way, looms large as a target for future development. With an eye to this future, Kaiser Aluminum & Chemical Sales, Inc., has made a presentation of aluminum design concepts to stylists of automobiles. Featured was a three-eighths scale model of a car made from the light metal. Depicted above, the *Pele*, named for the goddess of volcanoes, is aluminum from bumper to bumper. Functional components—engine, radiator, wheel, hub and brake drum—are also aluminum. The *Pele* was only one of several auto designs shown to Detroit stylists.

but . . .

General Motors Corp. says extensive use of aluminum in automotive engines and cooling systems will pose new antifreeze corrosion problems. Leonard C. Rowe of GM's Research Laboratories said antifreezes and rust inhibitors that successfully prevent corrosion in present auto engines and cooling systems may not solve the problem in aluminum components. In light of this, Rowe suggested that chemical manufacturers begin research programs to study the factors contributing to such corrosion—water quality; heat transfer; etc.

pressure vessel guide

A "Pressure vessel design handbook" has been developed by ACF Industries, Inc. It is a step-by-step guide that is said to eliminate need for lengthy computations. It will help engineers to determine simply and quickly the size of a pressure vessel where maximum working pressure requirements and desired capacity or space limitations are known. The handbook contains tables giving head and shell capacities per linear inch for various tank sizes, ranging from 48 in. ID to 131¾ in. ID. Computations to determine pressures listed are based on three common steels used in such vessels—A-285 grade C; A-212 grade B; and A-299.

Want a copy of the manual? Write: Marketing Dept., American Car and Foundry Division, ACF Industries, Inc., 750 Third Ave., New York 17, N. Y.

creator of jobs

The iron and steel industry accounts for a whopping 37% of the factory jobs in this country. For each iron and steel worker, there are nine workers in plants using iron and steel mill products. Not included in the 37% are many workers in non-manufacturing industries—mining construction, etc. —who are dependent to a great extent on steel. This same 37% receives 43% of all wages paid factory workers.

new isotope

Samarium 153 is a "potentially valuable" new radioisotope which emits low energy radiation. It was developed by General Motors Research Laboratories and has been used experimentally for both industrial and medical radiography. GM representatives, however, said Samarium-153 "will not replace an industrial X-ray machine in a fixed radiographic installation." Its main use would be in plant, field or laboratory areas where "portability" is desired. Seen as a "breakthrough in the field of low-energy photon sources," the new source will soon be made available to licensed users of industrial and medical isotopes.

a real blast

Testing materials with an explosive force of an atomic bomb without using any radioactive materials is possible with an Atomic Blast Simulator. The unique device was described at the recent ASME meeting in New York City by W. W. Boynton, director of the firm which designed it. Located at the Naval Civil Engineering Laboratory at Port Hueneme, Calif., the unit consists of a 20-ton steel pressure vessel, roughly cylindrical in shape, mounted atop a 75-ton heavily reinforced concrete pier. Engineers place the item to be tested (a beam, for example) inside the steel shell. A firing tube, also contained in the shell is loaded with enough primacord explosive to produce the desired blast.

What with explosive forming, explosive welding, and now this, we can foresee insurance companies rejecting applications from editors of *WE* . . . "occupational duties too risky."

Ah! for the solitude of a desk in the corner of a newsroom.

gold in them thar . . .

A smuggler alert to the advantages of welding, but not alert to the gendarmes, found himself in a Swedish jail last month. To get $33,000 worth of gold to a buyer in India, the smuggler welded the 28 bars into his automobile—a 1956 American make. He started out from Switzerland and with his car sailed from Genoa, but a double-cross and an ensuing chase resulted in his attempt to land in Sweden, where he was captured. Wonder what welding process he used . . .

Ansco guarantees structural strength

The only way to "guarantee" structural strength is to apply a safety factor. Superb Ansco industrial x-ray films are such a factor. They guarantee perfection of welds by their excellent sensitivity characteristics. Even discontinuities of less than 1% are faithfully recorded. Use Ansco's Superay "A" when speed and good readability are required. Use Ansco's Superay "B" when highest contrast and maximum definition are needed and speed is secondary. Contact your local Ansco representative, and get your guarantee of structural strength. Ansco, Binghamton, N.Y. A Division of General Aniline & Film Corp.

Ansco

Industrial X-ray

P.R.MALLORY & CO. Inc

MALLORY MEMOS

NEWS AND TIPS ON RESISTANCE WELDING

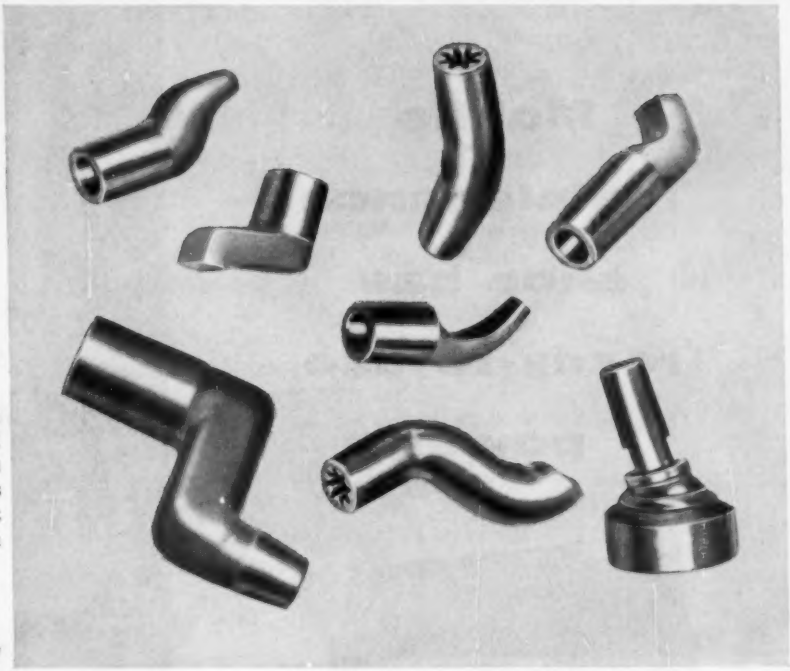
P. R. Mallory & Co. Inc., Indianapolis 6, Indiana

WELDING HINTS

To make it easy to remove electrodes from the holder, give the tapered end a thin wipe of light grease before you insert it in the holder. This prevents binding, helps the electrode pop out with the first tap of the hammer when you make a change in set-up.

Don't use white lead or similar compounds to seal a leaking taper. This insulates the electrode in the holder and leads to arcing and damage. If you've got a chronic leak, better ream out the holder and switch to new electrodes. (Mallory tips and holders, by the way, are precision-machined.)

Send for this useful chart of "Do's and Don'ts for resistance welding"—full of valuable ideas—ready to hang on the wall in your shop.



Need Special Electrodes? Mallory STANDARDS May Do the Job!

Here's a good way to save yourself the extra cost and delivery time for resistance welding electrodes for "special" jobs. Just check through the more than 200 types that Mallory distributors carry as standard, shelf-stock items. You'll probably find exactly the tips you need—at attractive cost, and delivered immediately.

It's a varied line; includes straight electrodes with pointed, dome, flat and other tip shapes, in several Mallory alloys to give you the combination of conductivity, hardness and strength you need. Also socket type electrodes, a broad selection of irregular shapes, threaded electrodes, and Elkonite® faced types.

It's a performance-built line, made to give you more welds per dollar through the use of Mallory alloys and production skills. Many types are available with the exclusive Mallory fluted cooling hole that gives extra long life.

Order from your nearby Mallory welding distributor. He'll be glad to give you a copy of our catalog which lists the complete electrode line.

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

Mobile maintenance shop has ready-to-use power

Lincoln 200 amp. *"Shield-Arc" Engine-Driven welder. Furnishes 115 volt DC auxiliary power for lights, tools, etc. Write for Bulletin SB-1337.*

There's no lost motion — no waiting for electricians, for special wiring or hook-ups when your maintenance man takes the power he needs to the job.

Weldynamics recommends ready-to-use power in the form of a Lincoln Engine-Driven welder mounted on a gasoline powered truck. This combination saves as much as 125 man hours per month for one manufacturer. Auxiliary power, standard on all Lincoln Engine-Driven welders, operates tools and lights, and 200 amp. welding current handles welding jobs with ease.

Mobile maintenance shops with Lincoln Engine-Driven welders are saving money for others. Why don't you put Weldynamics to work in your shop.

The World's Largest Manufacturer of Arc Welding Equipment

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JANUARY, 1959

Welding Engineer

ESTABLISHED 1916

A date to remember

TUESDAY NOV. 4, 1958, will go down in history—at least in welding history.

A party-shattering election took place that day. However, the date won't be remembered for that reason in the welding industry because on that day welding engineering came into its own and was formally recognized as a profession.

For years welding has acted as a whipping boy for American industry; it has been a trade without the rights and privileges of a trade. Weldors have been required to learn numerous skills and take on a large amount of responsibility—and still welding remains a so-called "tool," unrecognized.

By extension, it was only natural that some of this shoddy treatment should include the engineering end of welding. The welding engineer had his own problems when it came to industrial recognition.

Years ago Ohio State University saw a need and established a department of welding engineering to fill that need. The department has been graduating a few each year—*and each graduate receives dozens of job offers.*

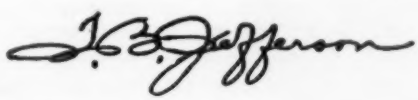
The need was evident; the curriculum was the best offered anywhere, yet educators looked down their collective noses—and the course was not accredited!

But the picture has changed since Nov. 4. The Engineering Council for Professional Development accredited the Ohio State University curriculum for welding engineering.

It was a great day for welding, and it may be the spark necessary to put welding in its rightful position among the various industrial trades. After all these years, we certainly hope so.

As a result of this recognition, welding engineering can begin taking giant steps in the American industrial world. The pattern has been set, and other schools can now establish their own welding engineering departments.

WELDING ENGINEER congratulates Professor Roy B. McCauley and Ohio State University for a great accomplishment, well done. It is a good omen for welding.



Carl Brainard, Sacramento, California, cutting steel plate with 44-year-old Victor torch butt and 38-year-old cutting attachment.

This old-time torch tells why . . . . .

The man on the job likes Victor Equipment

IT'S LONG-LIVED—Back in 1914, Brainard Bros., Sacramento, Calif., bought one of the first Victor welding torches, direct from L. W. Stettner, pioneer welding torch and safety regulator inventor, now president of Victor Equipment Company. Six years later Brainard Bros. added a cutting attachment.

IT'S FLEXIBLE—This outfit (shown here) has been in constant use ever since on the wide range of welding and cutting operations required in fabricating and repairing mining, logging and sawmill equipment.

IT'S RELIABLE—Victor's current model cutting tips and welding nozzles fit it perfectly—proof of Victor's lasting reliability.

You, too, can get this kind of service from Victor welding and cutting equipment. Ask your dealer to demonstrate why it pays to standardize on Victor.

VICTOR for welding

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; high pressure and large volume gas regulators; hardfacing rods, blasting nozzles; cobalt & tungsten castings; straightline and shape cutting machines. 51

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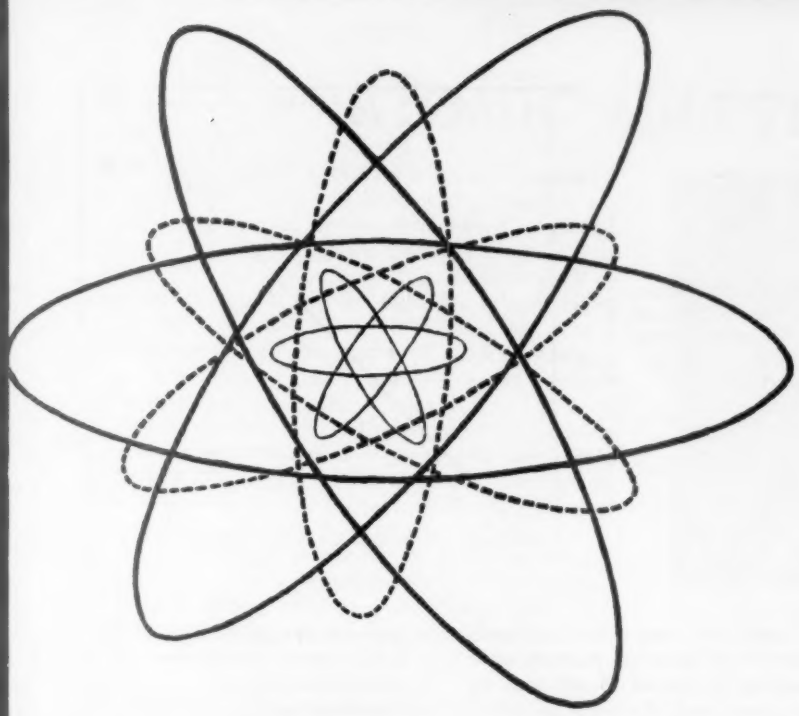


Welding Engineer

A guide to nuclear power

Part 2 — Nuclear reactors

by **W. D. Biggs**
Murex Welding Processes Ltd.

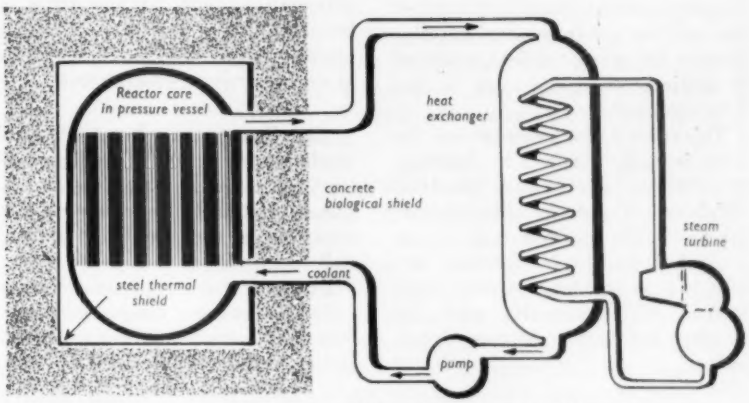


FIG. 1—Diagrammatic layout of a graphite-moderated, gas-cooled reactor.

NUCLEAR REACTOR FUELS may be classified into three groups: *(1)* natural uranium (containing less than 1% of the fissile isotope U^{235}); *(2)* enriched uranium (processed natural uranium containing a higher proportion of U^{235} after partial removal of U^{238}); and *(3)* plutonium.

Among the reactors, one type—thermal—is divided into two categories; heterogeneous and homogeneous. In the former, metallic uranium is surrounded by a moderator with each uranium rod encased in a protective sheath or can to prevent uranium oxidation or corrosion and escape of fission products. The rod and can together are known as a fuel element.

In a homogeneous reactor, uranium is used in the form of a suitable compound (*e.g.*, uranyl sulphate) which is then dissolved in a suitable liquid, such as water, and acts as moderator and coolant. In still another type of homogeneous reactor, fissile material may be dissolved in low melting-point metal, such as bismuth.

Basic layout of a heterogeneous thermal reactor is comparatively simple (Figure 1).

A suitable coolant is first passed through the reactor core where the heat is developed. The hot coolant is then piped to a conventional heat exchanger where its heat produces steam for normal turbine-power.

Coolants vary widely and may be either gaseous or liquid. (In England carbon dioxide is generally used because of its ready availability—although it possesses some disadvantages when compared with an inert-gas such as helium.)

The reactor core in this type thermal reactor is enclosed in a thick pressure vessel, and personnel are protected by a thick outer wall of concrete known as the biological shield.

The core of a thermal reactor does not operate at a very high temperature as is generally believed—although the fission reaction produces very high temperatures within the

uranium itself, possibly even melting it locally. However, this is confined to a small volume of material consisting of relatively few atoms, and the overall temperature of the fuel element rarely exceeds 842 F.

The effect is similar to a single arc strike which melts the steel locally under the electrode tip—but when the arc is immediately broken, there is little increase in plate temperature as a whole.

Several factors determine this comparatively low working temperature. First, sheaths and cans are generally made of aluminum or magnesium alloys having a low melting point. Secondly, the use of graphite as a moderator limits the temperature to be used.

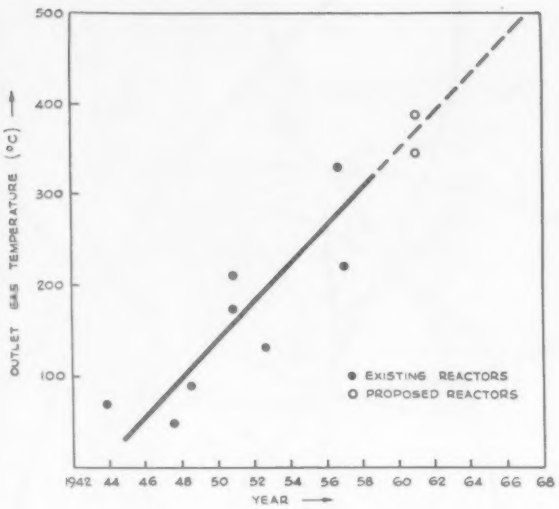


FIG. 2—Chart indicating the trend toward higher outlet gas temperatures in the gas-cooled reactors.

The most important reason, however, is that fission reaction slows and finally stops at high temperatures. (Thus there is little cause for alarm at the possibility of a reactor "running wild.") Apart from the complex control system in the core, a temperature increase would bring reaction to a complete standstill.

On the other hand, a heat-producing chain reaction must be controlled not only for safety reasons, but also because the amount of heat produced is relatively small and must be usefully extracted.

This control of a heterogeneous reactor is easily obtained by inserting or removing control rods of metal which absorb neutrons without forming fissionable products (*e.g.*, boron or cadmium). Such materials are said to possess a high capture cross-section, while materials used for canning are a low capture cross-section.

Among the water-cooled and moderated (homogeneous) reactors, some measure of control is achieved by the water itself, since pile reactivity decreases as water temperature increases. However, control rods are also employed.

Although there are many types of reactors now being fabricated or planned for future development, it is probable that power production will center around the following main types of heterogeneous reactors.

(1) **Water moderated and cooled** reactors which use light water (*i.e.*, ordinary water) as at Argonne National Laboratories, or heavy water, such as DIDO at Harwell, England.

Reactors of this type are not presently scheduled for power production, but are currently favorite in the United States where they are known as pressurized water reactors (PWR).

Boiling-water type reactors are inherently stable and avoid use of intermediate heat exchangers (steam can be fed directly into the turbine system), while use of natural or enriched uranium with heavy water moderation permits construction of very compact units.

(The Atomic Energy Commission has recently made contract agreements for two demonstration nuclear power plants, one at Piqua, Ia., and another at Elk River, Minn. The Piqua plant will be powered by a 12,500 electric kilowatt reactor moderated and cooled by a high boiling point hydrocarbon and fueled by slightly enriched uranium. The reactor at Elk River is to be a closed-cycle boiling-water type using water as a moderator and coolant, and a thorium-uranium oxide mixture as fuel.)

(2) **Graphite-moderated, gas-cooled** reactors, currently popular in England since graphite is the most satisfactory moderating material available.

The pressure shell for these reactors is cylindrical, due to limited facilities for pressing spherical segments of thick steel plate. Furthermore, a larger diameter necessitates an increase in the biological shield size as well.

Size and shape of the reactor core are usually a compromise. The best *working conditions* are obtained when height equals diameter, but the most efficient *heat transfer* is obtained with a flat, penny-shaped core. These reactor vessels must withstand cool-

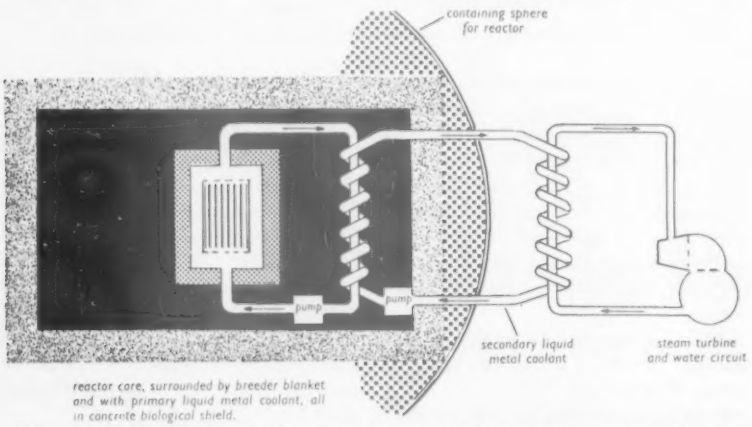

containing sphere for reactor
pump
pump
secondary liquid metal coolant
steam turbine and water circuit
reactor core, surrounded by breeder blanket and with primary liquid metal coolant, all in concrete biological shield.

FIG. 3—Diagrammatic layout of the liquid-metal cooled fast reactor recently built at Dounreay, Scotland.

ATOMIC MILESTONE

DELIVERY AND INSTALLATION of a reactor vessel after a tough 1,598-mile trip by barge and rail marked another important step in the development of atomic energy for peaceful purposes. Site: the Enrico Fermi Atomic Power Plant on Lake Erie, 30 miles south of Detroit—America's first full-scale, fast-breeder plant.

(Basic vessel design was formulated by Atomic Power Development Associates Inc., with final design and fabrication by Chattanooga division of Combustion Engineering Inc., New York City.)

Reportedly the most complex stainless steel pressure vessel of its size ever built—type 304 stainless in thicknesses up to 2 in., 36 ft high, and weighing approximately 91 tons—the reactor required the use of many large and costly manufacturing facilities.

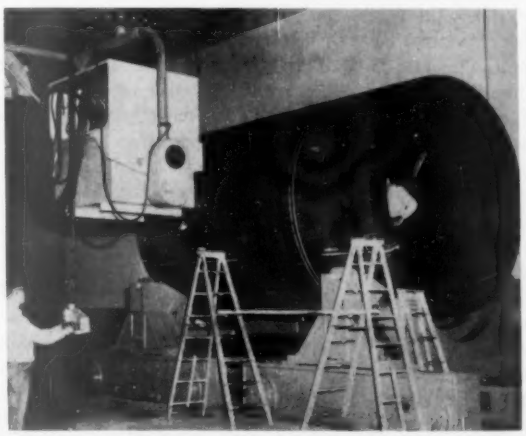
These facilities included a 15-million-volt X-ray machine, a huge high-temperature annealing furnace and large welding positioners. A 250-ton crane, 65 ft above floor level and spanning 80 ft, serviced this heavy equipment.

Fabrication problems confronted the weldors, who had to use mirrors to weld in a number of confined spaces. Some areas were as small as 11 by 15 in., prohibiting use of conventional safety helmets. In still other areas, weldors worked in doubled-up positions to reach the almost inaccessible spots.

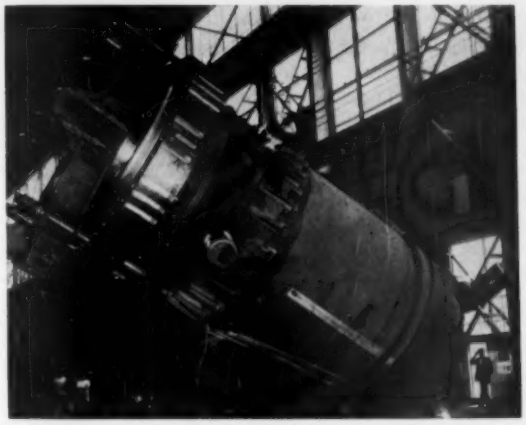
All weldors had to have certificates to weld the austenitic stainless. And prior to starting a new shift, each weldor had to run test samples to insure his welds would meet specifications and pass inspection. (In some instances it was necessary to qualify weldors each day.)

The reactor is made up of four separate cylindrical vessels welded together to form a single unit. Major components are the lower and upper reactor vessels, conical transition section and plug container, and the transfer rotor container.

Welding of the lower and upper reactor vessels to each other, and these in turn to the conical transition section, required nearly two months—including inspection and optical check time. (Total fabrication time was 28 months.) To avoid distortion, four weldors worked simultaneously, positioned to maintain alignment and keep machined surfaces parallel.



MAJOR welds are radiographed by a 15-million-volt betatron X-ray machine to insure against porosity.



REACTORS, such as the Shippingport reactor pictured, make extensive use of numerous welding processes.

Three different welding processes were used in fabrication: manual metal-arc, submerged-arc and Tig (tungsten inert-gas).

Manual metal-arc welding was employed in all difficult-to-reach areas, using E308-15 electrodes ranging from 5/64 to 3/16 in. in diameter.

Submerged-arc was used only when automatic welding machines were feasible, *e.g.*, complete girth welds or longitudinal seams. Filler wire was 308 type, 5/32 in. in diameter.

All welds on the vessel and its components required first-pass Tig welding to eliminate slag inclusions. Tig was also used on certain welds which could not be backed-chipped or inspected from the opposite side. In all cases, the first weld pass required a dye penetrant test—as did all completed welds.

Major welds were radiographed by the 15-million-volt betatron machine. Full penetration was required on 90% of all welds, and all weld edges received full profile machining, chipping or grinding preparation. (Total weld footage—including that on the shielding, rotating plug and other components—was 8,100.)

Preheating of weld joints and adjacent metal was not allowed to exceed 300 F, while stress relief (at 1,850 F in gas-fired furnaces) was required on all strength welds—with radiographic inspection both before and after.

In many cases, a weld build-up was required so that a weld profile could be machined to allow attachment of adjacent components to the vessel.

Almost all welding was done in the shop: about 35% of it by automatic machines, and the rest by manual methods. Because of the large amount of manual welding, credit for successful completion of the huge reactor goes to the shop craftsmen who performed their jobs with great skill.

ing gas pressure of about 100 lb per sq in., the hot gas being generally carried through mild steel ducting at flow rates of more than a ton of gas per second.

In this type of power plant the heat exchanger constitutes a barrier between reactor and generating plant. Thus any radioactive material which may be carried out of the reactor in the gas stream cannot enter the generating station, freeing it from possible contamination.

These reactors (although very large) offer the advantages of safety and of natural uranium as a fuel. Nonetheless, they are clumsy and can only be regarded as competitive if a market is found for their major by-product—plutonium.

This market can be provided by recycling or by using plutonium fuel in a more advanced type reactor, such as the one built at Dounreay, Scotland. *(See March issue of* WELDING ENGINEER, *page 34.)*

Graphite-moderated reactors have been compared to the slow-speed steam engine—reliable and, by now, almost conventional in design, without expensive or exotic construction materials.

With the need for high efficiency, future developments probably will include use of higher melting point metals for canning, such as beryllium, in order to raise the working temperature, and also the use of a fissile material impregnated in the moderator.

Such possibilities do, however, pose problems of some complexity, but if the present trend for higher gas temperatures continues, radical changes can be expected.

(3) **Graphite-moderated, liquid-metal** cooled reactors, offer many advantages and disadvantages; are not included in the present program for nuclear power production.

Such reactors, however, will operate best at very high power ratings and offer possibilities of higher operating temperatures and better steam conditions. With enriched uranium as a fuel, reactors of this type may well be in the second stage of the power program.

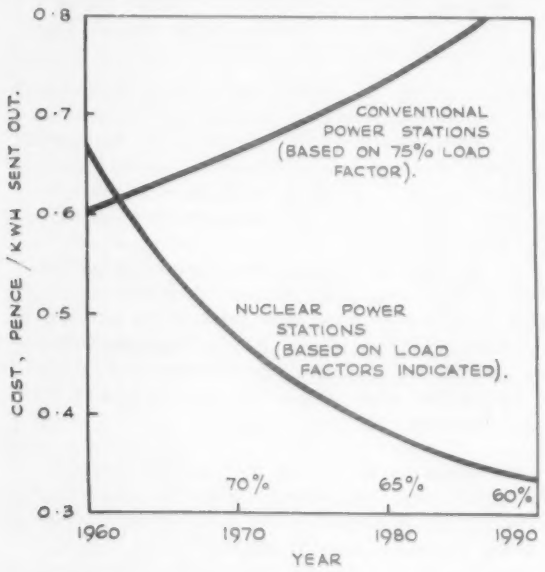


FIG. 4—A comparison of the probable cost of electricity from nuclear and conventional power stations based on continued use of graphite-moderated, gas-cooled reactors and available data.

In addition to these different heterogeneous reactors, it is also important to consider briefly the experimental fast (breeder) reactor at Dounreay, which has the merit of producing more fuel than it uses.

Its basic layout (Figure 3) is essentially the same as a gas-cooled reactor, but absence of a moderator reduces the core size to a small cylinder 2 ft in diameter by 2 ft high. The core is housed in a stainless steel vessel carrying the liquid-metal coolant.

Stainless steel is also used for canning the blanket elements which are to be converted into plutonium, while the whole unit is housed in a massive concrete vault and enclosed in a low-alloy steel sphere.

Figure 4 shows that in the initial stages of nuclear power production, net cost per kwh sent from nuclear power stations will be marginally higher than from conventional power stations.

This prediction—made by Sir Christopher Hinton at the Royal Swedish Academy of Engineering—is based on available data and the continued use of graphite-moderated, gas-cooled reactors, which have the greatest development possibilities.

Most significant factor in the cost question is probably the increased price of coal for conventional stations (although capital reductions and lower operating costs have absorbed the increase). Capital cost of a nuclear power station is admittedly high, but with attainment of higher top temperatures reduction of capital and operating costs are certain.

Mention should also be made of thermonuclear fusion—in which the energy released by combination of atomic nuclei may be used.

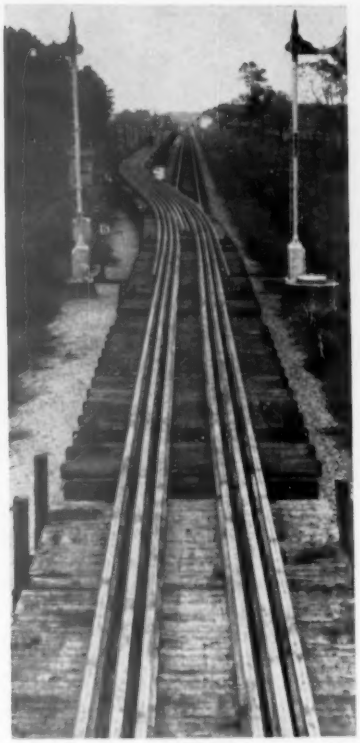
Best known example occurs in the sun—and since the sun's temperature is in the region of 15,000,000 F, similar temperatures must be used to produce measurable amounts of nuclear energy by this means.

Recent experiments by British scientists have produced temperatures up to 5,000,000 F for several milliseconds. By atomic standards this is an extremely long time, and was obtained by discharging some 200,000 amp through deuterium (heavy hydrogen) gas. Temperatures approaching those of the sun are anticipated for the near future, but even higher temperatures will be necessary before appreciable amounts of energy can be produced.

(It is estimated that temperatures of 100,000,000 F will have to be attained before the "break even" point is reached, *i.e.*, where energy produced is equal to or greater than that fed into it.)

There are many formidable scientific and engineering problems to be overcome before thermonuclear fusion becomes a commercial proposition. But since there is a readily available and almost inexhaustible supply of deuterium in the oceans, production of nuclear energy by this means is a worthy target.

(Part three of this series on nuclear power will deal with metallurgical problems. Look for it in a future issue of the WELDING ENGINEER.*)*



WELDED rails are flexible enough to bend with turns on way to installation site. The quarter-mile lengths are laid side-by-side.

ENDS of two 39-ft long sections of rail are flash butt-welded under 30 ton pressure. Upset caused by 50-ton blow is then sheared off.

Swiss rail-welder in production at NCG

THE "CLICKETY-CLACK" of railroad tracks is fast joining the steam locomotive whistle on the road to oblivion.

A new method capable of saving U. S. railroads millions of dollars annually in track installation and maintenance costs, and providing reduction in freight and stock damage, has joined the list of continuous welded rail systems available.

A product of Chemetron Corp.'s National Cylinder Gas Div., the system is the first automatic electric rail-welding system to be manufactured in the U. S. (Exclusive manufacturing rights were obtained from H. A. Schlatter AG., Swiss producer of resistance welders.)

The first NCG unit has been sold to Southern Pacific Railroad and another has been leased to Great Northern Railway and the Louisville & Nashville Railroad. (See: *Wabash Railroad proves economy of welded rail,* WELDING ENGINEER, Feb., 1958, p. 32.)

Continuous welded rail first made an appearance almost 30 years ago, and since that time railroads have been chafing at the bit to install this cost-saver. (An annual savings of $981 per welded track mile over conventional bolted rail has been reported by the American Railway Engineering Association.)

Why the delay? High expense due to slowness of previous welding methods has hindered use of welded rail except in certain areas of difficult maintenance and replacement—less than 1% of the nation's rail mileage. Improved welding processes and automation have eliminated this hurdle.

THE QUESTION most frequently asked of railroads is: *"What about expansion and contraction caused by temperature changes in welded rail several hundred feet long?"*

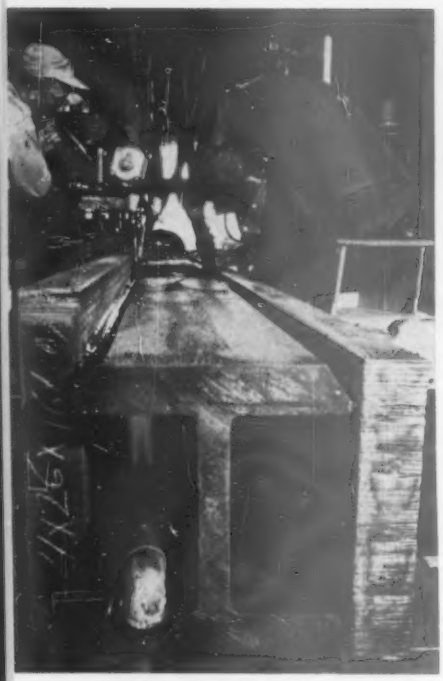
A long stretch of continuous welded rail is restrained from expanding and contracting longitudinally by rail anchors, spikes holding the rails in place, frictional resistance on the tie plate, as well as the gripping action of the plate shoulders. This combined resistance minimizes expansion and contraction to a small movement at each end.

NCG's unit welds at a rate of two to three times faster than other rail welding systems, according to the company. Completing one weld in about 4 minutes, the system requires only 7 men—one-half the size of other electric rail-welding systems.

Mounted on railroad cars for fast and easy re-location, the system preheats each rail-end to a plastic state, then falsh butt-welds the ends with a 50-ton blow.

Upset metal is sheared off and the weld is smoothed with grinding belts. (Belts are used to avoid possible grinding wheel burns.)

The quarter-mile strings of rail are loaded on a train of 34 flat cars, a dozen rails side-by-side or stacked, and moved to the installation site. Two rails at a time are removed by anchoring the ends and pushing the cars out from under them.



FOUR-ARC unit makes submerged-arc welds on 65-ft upright as operators check on flux supply and inspect weld. Upright is composed of 14-in. I-beam and two steel slabs. Gas-fed flame at bottom preheated assembly, now relieves stresses during welding.

Napa's biggest job:

Kaiser plant welds legs for giant offshore tower

A GIANT, 4,500-ton offshore working tower—believed to be the largest movable structure ever built, exclusive of ships—was recently towed down the California coast to El Segundo from its assembly area in San Francisco Bay.

This tower represents one of the most extensive welding projects undertaken in the West, requiring tens of thousands of man-hours, and hundreds of miles of welding wire and electrodes.

Its legs alone, fabricated by Kaiser Steel Corp.'s Napa (Calif.) plant, required the attention of 25 weldors and dozens of additional craftsmen over a period of seven months.

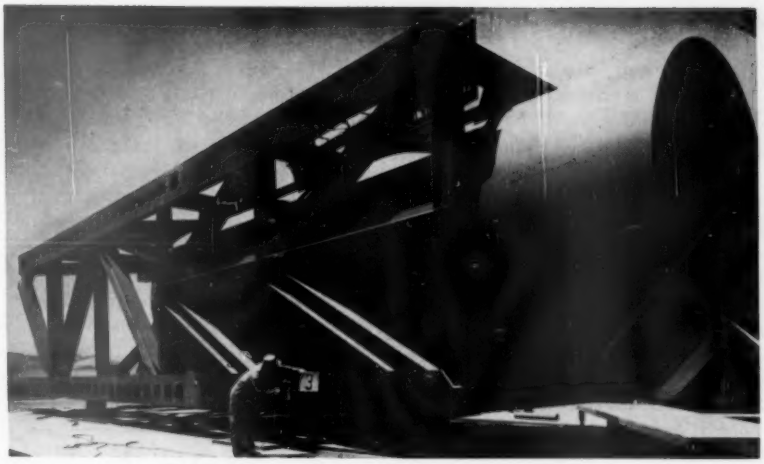
The hydraulically-operated tower is part of a three-year, $60,000,000 project to expand Los Angeles sewerage facilities. It will be used to lay 192-ft sections of 12-ft-diameter effluent outfall pipeline from the city's main treatment plant to a point five miles out in the ocean.

Basically, the job involves the end-to-end assembly and fabrication of 16 sections, each 17 ft square and 65 ft long. They formed four 700-ton supporting legs for the 122½-ft by 190-ft platform. To simplify the complex welding operation as much as possible, Napa engineers laid out the work in a manner that permitted a five-step assembly-line procedure.

Step one called for tack welding two 65-ft steel slabs—one 26 in. wide and 4 in. thick; the other 19 in. wide and 3¾ in. thick—to each side of a 14-in., 426-lb wide-flange beam. This slab-and-beam assembly forms one of four upright members for a leg section; four such sections, welded together, form a tower leg.

In step two, uprights were joined permanently with a tandem, four-arc, automatic submerged-arc welding set-up. The 33-ton assembly was

TWO collars fitted over tack welded leg section and resting on idler rolls permit positioning of work for downhand welding. Rectangular jacking holes on top and bottom uprights were flame-cut to 1/16-in. tolerance.



PAINTING is last operation at Napa plant before sections are shipped to assembly area in San Francisco Bay. Large welded tank in this leg section identifies it as bottom section. Open edge of tank at right will bite into ocean floor when leg is jacked down, giving greater stability.

placed on a movable table passing beneath the welding heads.

Because of the thickness of these uprights, a gas-fed flame was directed into the end of the assembly before and during welding to preheat it and to relieve stresses. When both sides had been welded, the assembly was placed in a furnace for final stress relief.

For step three, the uprights were placed in a jig to form one side of a leg section. Two uprights were positioned parallel to each other and 14-in., 426-lb wide-flange beams were welded into place as cross members.

Before a side was completed, a series of 10¼-in. by 12½-in. holes were flame-cut in the 4-in. plate. These jacking holes had to be cut to a 1/16-in. tolerance to secure precise balance when the 1,700-ton platform is raised or lowered on its legs.

In step four, completed side sections were placed in another jig where two sides were tack welded to 14-in. I-beams to form the final square leg section.

Step five—finish welding the tacked leg sections—was the most extensive of all the welding operations. In setting up welding techniques for this particular job, Napa engineers created a real problem by specifying that overhead welds be avoided wherever possible.

The sections weighed over 175 tons, exceeding the lifting capacity of the shop's overhead cranes. Plant project engineers, casting about for a method of rotating the sections, conceived the idea of utilizing two welded "collars." Fitted over the square sections, these 27-ft-diameter fabrications would enable sections to be rolled.

To facilitate collar placement, two 50-ton overhead cranes were used. One held an end of a section secure, the second crane lifted the free end, and the collar was slipped on. The operation was repeated to fit the remaining collar.

Cables attached to the sections were pulled by the cranes, turning work easily for downhand welding on all areas. When welding was completed, collars were removed and sections lowered onto a heavy plate swivel.

To move them out of the shop for painting, sections had to be turned on this swivel and aimed at a side door. Six 50-ton roller jacks were then placed under them and a tractor pulled them into the yard.

Completed sections were winched aboard barges at Kaiser's wharf and taken down the Napa River to the assembly point on San Francisco Bay. There, the first sections were fitted into a square opening on each corner of the floating platform.

These were then jacked down to a solid footing and the platform was raised out of the water. The second, third and fourth sections of each leg were hoisted into place by a crane on the deck of the platform as hydraulic jacks continued to raise it.

The finished tower was towed to its working position off southern California by a group of powerful tugs.

The $20,279,000 contract for construction of the outfall pipeline was awarded to Hyperion Constructors, and Kaiser Steel Fabricating Div. was one of several sub-contractors for construction of the outfall tower.

SILHOUETTED against late afternoon sun, tower nears completion. A-crane on platform hoists leg sections into place. One more section will be added to three tallest legs; shorter leg will have two more sections added to it.

Here's news for those who want to work with molybdenum, but who worry about correct design and welding methods.

Producer gives instructions for welding moly

By **R. R. Freeman** *and* **J. Z. Briggs**
Climax Molybdenum Co.

IN THESE DAYS of ramjets and rockets, enthusiastic space buffs become fascinated by the externals of the satellite saga; countdowns, launching pads and control devices command more attention than less-advertised, but equally great problems which engineers must face and solve before a rocket hurls toward space.

One obstacle to be surmounted before man reaches the stars is *heat*. For example, when a metallic body enters or leaves our atmosphere, it is exposed to tremendous temperatures. It is for this reason that few meteorites ever strike the earth: frictional heat ignites and burns them.

How, then, can engineers cope with this situation? Their best answer to date has been welded, heat-resistant metals. Researchers have found metals which can withstand temperatures great enough to wilt ordinary materials like candles before a hot stove—and yet not lose their strength.

Molybdenum and Heat

One of these high temperature metals is molybdenum. Molybdenum has a melting point of 4,730 F, making it much "colder" at room temperature than steel or aluminum.

Because of these properties, it is in demand for gas turbines, ramjets and rockets. In sheet form it supplies plate elements for vacuum tubes. In wire form, it serves as heating elements in electric resistance furnaces.

Temperatures above 1,700 F are critical. Because molybdenum resists heat much above this level, and since it has a low thermal neutron cross section, it may very well be used in the future as a primary construction material for nuclear reactors.

This high-temperature strength has also caused engineers and designers to look hopefully to molybdenum as a metal for critical parts in planes and guided missiles.

Unexplored Territory

But before researchers tackled the problem, there was little chance for the metal to be used at peak efficiency because of scant information on welding methods.

Now, however, universities and aircraft companies, after having dedicated six years of experimentation in a program sponsored by the Office of Naval Research, believe they have the answer.

Part of that answer is molybdenum-base alloys and part is arc-cast molybdenum sheet. The alloys have much more high-temperature strength than unalloyed metal and, above 1,700 F, are stronger than any metal used before.

Arc-cast molybdenum sheet can now be welded on a semi-commercial basis and has moderate ductility at room temperature and is as ductile as the parent metal at slightly higher temperatures.

This simply means that the metal, although it will allow only a limited amount of assembly and forming, can be *welded*.

When planning to weld molybdenum, then, several design factors should be borne in mind . . .

¶Arc-cast molybdenum can be welded without porosity or cracks; this is generally not true of commercially sintered molybdenum.

¶If arc welding conditions are optimum, joints will take a longitudinal free bend of 120 deg at 80 F. But, if welding procedures are not closely followed, weldments usually have a low bend ductility at room temperature. (This can be improved, however, at 200/400 F.)

¶Even minute quantities of oxygen and nitrogen lower ductility, not only in the parent metal but also on the surface and in the welding atmosphere.

For this reason, welding must be done in a controlled atmosphere. Commercial argon, helium and hydrogen may contain enough oxygen to cause porosity and cracking unless special cleansing measures are followed. One of these is electrolytic polishing of the faying surfaces, which removes contaminated surface layers formed during processing.

Elements and Ductility

¶Although it is known that compositions other than oxygen and nitrogen appear to affect ductility, the exact role of carbon, aluminum and alloying elements is relatively unknown.

¶To avoid uneven response to forming of the weldment, recrystallize and hot form it. Molybdenum must be reduced at least 50% in section after recrystallization, or room- and high-temperature strength will decrease.

¶Characteristic of molybdenum cause problems in some types of welding—especially resistance.

Brazed joints may be more ductile than welded joints, provided that temperatures over 1,700 F are minimized. Brazing is not, however, suitable for all uses because many filler metals employed at low temperatures are not satisfactory at high temperatures.

¶Mechanical means of joining, such as riveting, offer some possibilities. However, joints will not be gas- or liquid-tight.

Little experimentation has been done on such mechanical joint combinations as lock seams followed by brazing or welding.

¶It is absolutely essential on any welding application (molybdenum can be welded to itself or to any

metal with which it readily alloys by either the resistance or arc welding processes) that all surfaces to be joined are completely cleaned.

In arc welding molybdenum, for example, whether the process be atomic-hydrogen, Tig (tungsten inert-gas) or Mig (metal inert-gas), faying surfaces and adjoining areas must be completely free of oxides.

Electrolytic polishing seems to give the greatest assurance of cleanliness. Some fabricators, however, prefer etching in a sulphuric acid-chromic acid solution because of its simplicity.

The three welding methods mentioned above are most effective on relatively heavy parts and sheets over 1/32 in. thick; they have also been employed on thinner sheets. Tungsten electrodes are used with or without filler wire additions.

Helium and argon are used as shielding gases depending upon the welding set-up, although helium is preferred by many because of greater arc heat. An inert-gas chamber is not needed if shielding is adequate.

Manual Arc Welding

Manual arc welding can be done, but it is not as reliable as automatic welding.

But whether Mig or Tig is chosen, oxygen and nitrogen must be carefully controlled since they have a negative effect on ductility. Only purified argon and helium, therefore, can be used. These, of course, are today's commercially available types. Carbon dioxide cannot be used with Mig.

Oxygen should not exceed 0.005% in the atmosphere and nitrogen must be held well below 0.1% for maximum ductility. For this reason, purified gases are best.

Preheat may or may not be used as the fabricator wishes. When welding complex assemblies, a preheat of 400 F has been found efficient.

Corner and edge welds are more easily made than butt welds. And butt welds, in turn, are less difficult than fillet welds.

Butt Welds on Sheet

On sheet, butt welds are excellent up to 3/32 in.; greater thicknesses call for multiple passes in a vee-butt joint. Filler wire additions are needed for multiple-pass jobs, and a 400-F preheat should be maintained during welding.

Occasionally, on long weldments requiring multiple passes, weld metal may oxidize as it emerges from the protecting atmosphere. In such cases, chemical cleaning or electrolytic polishing must be done before making the next pass.

Parts to be stretched or formed after welding are best joined with filler wire, which lessens demands for precise fitting of details and also reinforces the weld. Arc cast molybdenum, with its lower gas content, is preferred for filler wire when ductile welds are desired.

Because amperage and travel speed depend largely on the fixtures and chills being used, they are determined by trial. As a general rule, however, the faster the travel speed the more ductile the weld, *if* there is time for complete penetration and *if* the shielding gas prevents atmospheric contamination.

Stress Relief

Stress relief is recommended in all cases. But timing and temperature should not be such as to allow parent metal recrystallization unless considerable forming is to be done.

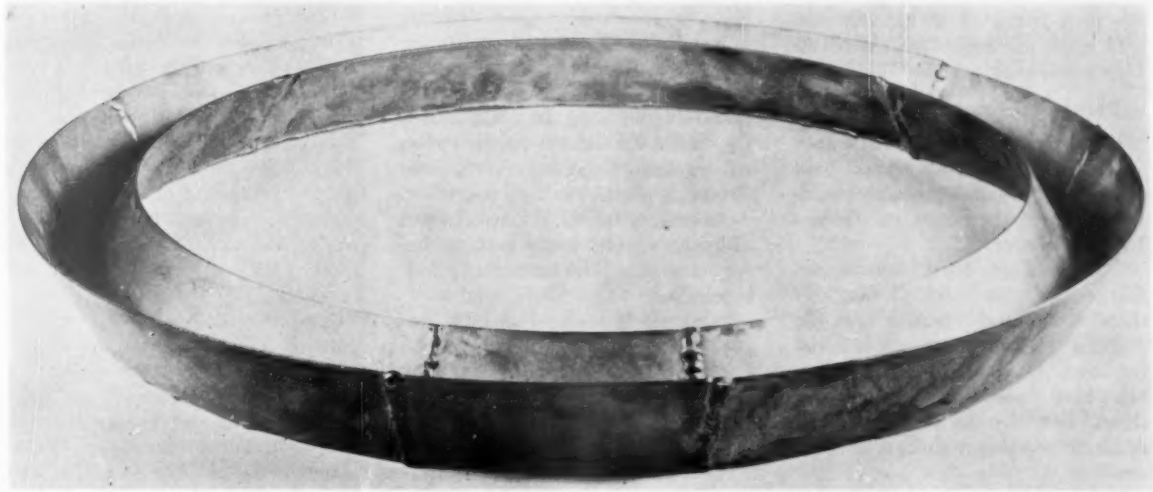
There are two ways to improve weld and heat-affected zone ductility: roller levelling or roll planishing at about 600 F, or post-weld grinding to smooth the surface and to remove any microcracks that might raise stresses.

Even though resistance welding has long been used by the lamp and electronic industries on small parts, the method has its limitations. These consist of joint brittleness and sticking and deformation of electrodes on spot and seam welding.

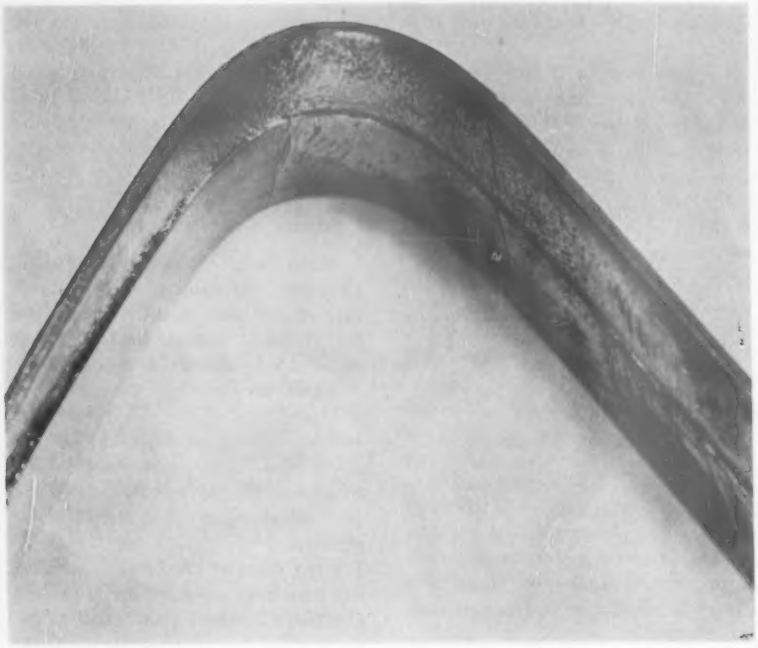
To overcome this problem, copper, copper-alloy, molybdenum and tungsten electrodes have been tried. None have proved satisfactory. Cooling or refrigeration of electrodes may help in this situation.

Foil Sandwiches

The electronic industry also sandwiches nickel or platinum foil between molybdenum sheets or wires for a combination braze-weld. For this work they use either a-c or d-c



FLAME gutter, arc welded in helium atmosphere. Inner and outer annular ring sections were joined at apex junctions; then entire unit was butt welded. Preheat temperature of 400 F was maintained throughout.



LEFT: Longitudinal free-bend test specimen welded by Wright Aeronautical Div. of Curtiss-Wright Corp. Arc welded in a helium atmosphere at 30 ipm, this piece of arc-cast molybdenum bent 120 deg before fracturing. BELOW: Tig welded in an argon field, this unit, 0.030 in. thick, was bent 90 deg at 200 F. No filler rod or inert-gas chamber was used by Marquardt Aircraft Co. weldors

welding equipment, and have a choice between a condenser-discharge welder or an ignitron type with a half-cycle timer.

If design permits, one of the sheets to be joined by projection welding should be dimpled or sandblasted. Sheets to be spot welded should have their surfaces etched.

One etching method entails submerging the sheet for about 10 seconds at 195 F in a solution of five gallons concentrated sulphuric acid, one quart hydrofluoric acid, 0.1 quart concentrated nitric acid and 375 grams chromic acid. The sheets are then immersed in hot chromic-acid glass-cleaning solution until the blue oxide disappears.

Percussion and Flash

Other favorable results have been obtained with percussion and flash welding, and simple pressure welding in a dry hydrogen or oxygen-free atmosphere.

These methods have been successful because they weld so fast that there is no grain growth and the original molybdenum strength is unimpaired. Some ultrasonic welding has been used on molybdenum sheets, but like the other methods, available equipment limits it to small sizes.

Molybdenum can be readily brazed with a large number of metals and alloys, with choice depending upon available equipment and use of the finished product. Generally, however, brazing is done by induction, resistance or in controlled-atmosphere furnaces.

Brazing methods can be tested by working on well-fluxed molybdenum with an oxyacetylene torch. But particular attention must be paid to selection of a brazing technique when parts are to be given a final protective coating at high temperatures—especially if these temperatures are above the brazing alloy melting point.

When high service temperatures are not involved, copper (melting point: 1,981 F) or silver brazing alloys are usually chosen. One such alloy is a silver brazing composition containing 50% Ag, 16% Cd, 15.5% Cu, 15.5% Zn and 3% Ni. This gives an excellent braze on electric and electronic parts.

As little as 0.25% P can be added to improve molybdenum wetting, but for maximum joint strength, 1% P is required.

Some use is made of an 80% Au-20% Cu alloy (melting point: 1,635 F), and a 82.5% Au-17.5% Ni alloy with a melting point of 1,740 F.

Flux for Brazing

If all parts are cleaned, no flux is necessary to resistance braze thin sheets of molybdenum in a spot or seam welder. Copper-alloy electrodes may be used, but tungsten-faced electrodes are superior.

Heavier sections can be brazed without flux if the operation is carried on in a hydrogen furnace. As an added aid, a preliminary coating of nickel or copper will help in brazing molybdenum to copper or to itself.

Of course, electronic parts and other non-structural parts often involve temperatures above the melting point of copper or silver brazing alloys. For these, a copper-nickel alloy with 10% to 30% nickel have been used with effect. In special cases, employ 70% Ni-30% Mo alloy (melting point: 2,425 F).

Higher operating temperatures often require the combination of *pure* nickel (melting point: 2,651 F) and platinum (melting point: 3,224 F). These are used in wire or foil form. A molybdenum-boron powder is suitable for hydrogen brazing (melting point: 3,450 F).

Molybdenum can be brazed in a hydrogen, helium or argon atmosphere, if the graphite is not in tension. A gold-nickel-chromium alloy with 72% Au, 22% Ni and 6% Cr

has given good results.

Brazing Limitations

Despite the encouragement of these figures, many brazing alloys have been tried for high-temperature structural applications, but none have proved to be satisfactory for all operations.

For example, a nickel-chromium-boron alloy (AMS 4775) is good for work up to 2,000 F in a hydrogen brazing; it is unsatisfactory for brazing in a vacuum. On the other hand, silver-palladium, palladium-iron, nickel-titanium and columbium-nickel alloys have proved successful in vacuum brazing but may not be suitable for hydrogen brazing.

Soft soldering is not commonly used on molybdenum, despite the fact that one government laboratory developed a method by which solder, such as Wood's metal or 60-40 lead-tin, was loaded on an abrasive wheel and transferred to the molybdenum.

Thus, while welded joints on molybdenum presently have only about 50% of parent metal strength, work is continuing to improve this figure.

On a more positive note, it has been learned that welds can be produced with molybdenum to have room-temperature ductility, and that the metal *can* be protected against oxidation. The future seems to promise that molybdenum will become popular for uses at temperatures above 1,700 F.

Chemists find new moly cleaning method

DESPITE ALL its advantages at high temperatures, molybdenum has one great drawback: it is almost impossible to weld unless it is completely clean. But difficult cleaning processes now have been simplified by a development of Ryan Aeronautical Co.

Heretofore, molybdenum has been deoxidized by a number of methods, none of which have been highly successful. This can be traced to three causes: deoxidation must be done at high temperatures; the metal is attacked by the deoxidizing agents, and chemical components used are often dangerous to personnel.

One method utilizes a molten salt bath of 70% sodium hydroxide-30% sodium nitrate. Bath temperatures range from 500 F to 700 F. Molybdenum is attacked by this solution and it must be closely controlled to prevent metal loss. (The molten salts also present a potential explosive hazard if any water should accidentally be added to them.)

MOLY sheet is inserted in alkaline bath following deoxidation (see text).

Chemical Cleaning

After molybdenum is descaled by the bath, it is placed in concentrated sulphuric acid containing 3.5% saturated sodium dichromate solution for chemical cleaning.

A second deoxidizing technique is the anhydrous (water-free) bath. Its main components are: 95% sulphuric acid, 4.5% nitric acid, and 0.5% hydrofluoric acid. Although temperatures are low—195 F—the bath does not clean satisfactorily and is difficult to keep anhydrous.

Another bath, consisting of 25% nitric acid and 2% hydrofluoric acid by volume, readily removes oxide but later attacks the metal.

Still another method—electro-polishing in 80% sulphuric acid-20% phosphoric acid by volume—has been tried. Although it deoxidizes, it too adversely affects the metal.

Oxidizing without Attacking

Finally, molybdenum can be cleaned by sand or vapor blasting. Unfortunately, this method is not practical on complex parts because of the risk of entrapping sand.

The Ryan method involves two chemical baths that remove all oxides without harming the base metal.

Resulting from the knowledge that molybdenum resists attack from aqueous alkaline solutions, the first bath is a deoxidizer; mainly sodium hydroxide with potassium permanganate added.

Chemically, this converts molybdenum oxides to a higher valence state, which can easily be removed by a pressure-spray rinse. A black smut is left after the rinse, but is washed off by a second bath containing acids harmless to molybdenum.

The alkaline bath is 10% sodium hydroxide, 5% potassium permanganate, and 85% water by weight. Sodium hydroxide is the key to the solution and its proportion must not be less two parts to each part of permanganate.

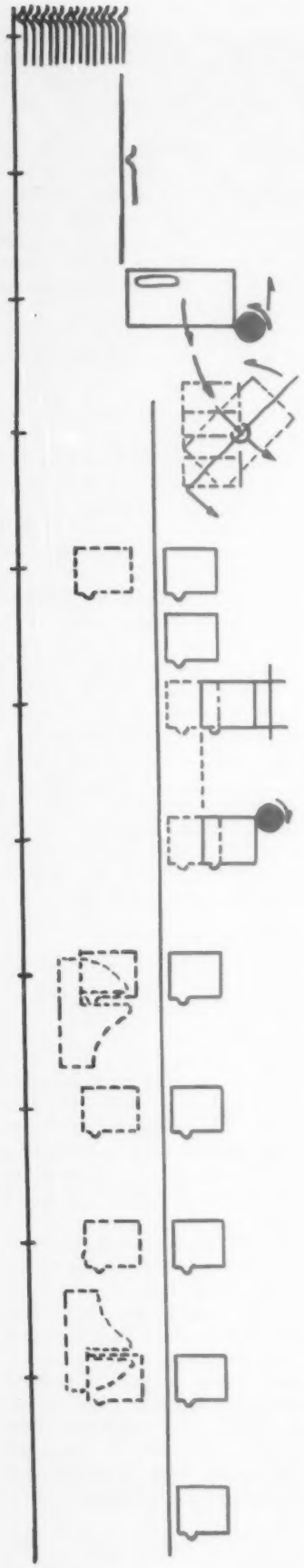
Reasons for Success

The reason this bath succeeds is that a highly oxidizing manganimanganate complex forms when sodium hydroxide reacts with potassium permanganate. The same complex could be obtained by fusing sodium hydroxide with manganese dioxide, then dissolving in water.

The molybdenum is immersed for 5 to 10 minutes in this solution, which has a temperature of 150 F to 180 F.

After the metal has been rinsed, black smut is removed in the second bath of 15% sulphuric acid, 15% hydrochloric acid, and 70% water —plus 6% to 10% weight/volume of chromic acid.

The mixture is held at ambient temperature and the metal is immersed from 5 to 10 minutes. If the oxide has been entirely converted by the caustic bath, this will complete all necessary cleaning.



EIGHTY foot automated tank line can produce 150 units per hour using only two men. Horizontal lines at left mark off the 11 stations.

Refrigerator fabrication has become highly competitive—so this manufacturer met the challenge with . . .

"Flexible automation" on refrigerator welding lines

COMPETITION AMONG manufacturers of electric refrigerators has always been high—and with automation's continued rise in industry, it has become a daily challenge.

Norge Div. of Borg-Warner Corp. has met this challenge with three new automated welding lines: one each for the fabrication of cabinets, food compartment liners (tanks), and doors.

The most important feature of these new lines is that none is confined to making only one design or size—promoting the system from ordinary automation to what the company terms "flexible automation." All three lines can handle at least four different designs and can produce any of these in several different sizes.

Since changeover time is also greatly reduced, the new setups are almost universal—at least as far as main components for Norge refrigerators are concerned.

The refrigerator cabinet line (150 ft long with 20 panel-controlled stations) can turn out 150 cabinets per hour, or one every 8 minues, 48 seconds. Only eight men, including the operator on the heavy blanking press, are needed.

Production on the cabinet starts with oblong blanks of one width and three different lengths up to a maximum of 17 ft 6 in. The 20-gage steel blanks in each case are long enough to form the top and two sides of a cabinet.

All welding on the three lines is done by resistance methods, using 2,000-amp, 60-cycle, a-c current. Number of transformers and their kva ratings in the cabinet line are: one 45 kva; thirty-eight 50 kva; eight 65 kva, and two 75 kva transformers.

Resistance welding electrodes used are: 156 $\frac{5}{8}$-in.-diameter spot weld dies; two $\frac{1}{2}$-in.-wide by 5-in.-diameter seam welding wheels; and 16 flat or projection-type electrodes.

Blanks are first placed on an elevating table at one end of the 200-ton blanking press for notching and piercing. The blank is then discharged and advanced to a set of Yoder rolls which form a flange on one edge and a channel-like double flange on the opposite edge.

The piece is moved automatically and transversely into station 1 and then on to station 2, where minor handset brackets are spot welded to

the panel. At station 3, panel ends are U-formed upward to form a three-sided assembly.

Here, also, two mitered joints are formed at front flanges and then mash seam welded. At stations 4 and 5, back panel subassemblies (31 or 28 in. long only) are spot welded on 2-in. centers along rear flanges. Station 6 is idle. Cold planishing rolls at station 7 press against the mitered mash weld to give a smooth finish.

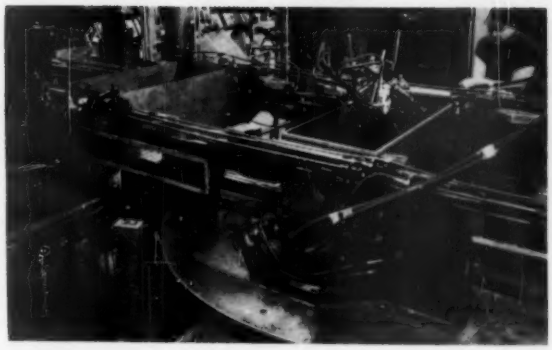
At station 8, a cross-rail subassembly is spot welded in two places at each end to the front outer-face flanges. Similar welds are made on outer and inner flanges at station 9.

Two upper corner gussets are spot welded at station 10, while other welds join lower corner gussets at station 11. Tank-mounting brackets are spot welded at the next station, and a side bracket is welded to the tank at station 13.

Front inside corner brackets, a bottom panel and two side tank-mounting brackets are welded to the cabinet at the next three stations.

In station 17, the bottom is spot welded to side flanges while a bracket is joined to the cross-rail. A 90-deg bend-and-form operation is applied to the cabinet bottom at the next station, and at station 19, two bottom gliders are spot welded to the assembly.

When the cabinet has been indexed to the last station, it is rotated and turned 90 deg and released for inspection. (Indexing from station to station is entirely automatic, in most cases using carriages on overhead tracks.)



TANKS move into the fourth station for expanding, embossing and flanging. Expanding prevents distortion during enamel baking.

The food compartment liner (tank) line—80 ft long with 11 stations—can make tanks in two widths and five lengths. (Lengths range between a minimum of 35 in. and a maximum of 47½ in.) Unlike the cabinet, which is produced on end, the tank is horizontal at most stations.

Oblong blanks in mill-run widths are first sheared to length and fed into press for notching and forming. Vacuum-cup transfer devices then deposit the blank on a flipover, and a wrap-around machine forms the box with a top overlap. With mash seam welding of the overlap, an oblong four-walled box without flanges results.

The box is then rotated 90 deg on a horizontal axis so that open ends are top and bottom. At the fourth station, the box is expanded to remove buckling and to prevent distortion when its enamel coating is baked.

The expander produces stiffening embossments in both ends, then forms flanges inward at the bottom and outward at the top. At the sixth station, a pre-pierced back panel is clamped against copper backup bars along the side back flanges. The two flanges are simultaneously mash seam welded. At station 7, similar welds are made on the back top and bottom flanges.

In the next five stations all required holes are pierced in the tank, and at the final station, pressure is applied to rolls which planish all four seams. The tank is then fed onto a gravity conveyor.

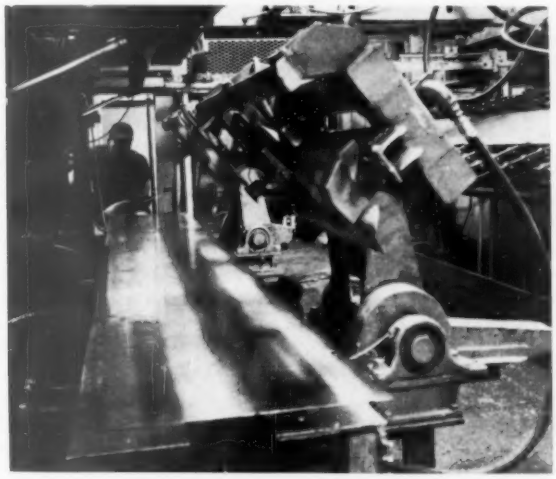
This new tank line uses only two men compared to the 10 previously required—yet 150 tanks per hour, or one every eight minutes, can be produced. Current requirements are the same as on the cabinet line, but only five ½-in. by 12-in.-diameter seam welding wheels are used. Power sources are one 200-kva and two 300-kva transformers.

In Norge's third automated line, doors are produced in 24- and 34-in. widths, and in varying lengths. (Both single and dual-door types can be fabricated.)

The door panel is drawn and flanged prior to reaching the line, and parts to be added are small and quickly placed. The line requires only three men to produce 250 to 300 doors per hour (one minute 12 seconds per door).

This last line uses twelve ⅝-in.-diameter spot welding electrodes; four ½-in. by 4-in.-diameter seam wheels, and two projection welding electrodes. Power sources are: four 50 kva, two 65 kva and four 75 kva transformers.

Overall benefits of the three lines are considerable—and justify Norge's $3 million investment. It is estimated that the lines will be in use for a full five years. Although new model changes are anticipated, necessary changes can be made on the lines to prevent obsolescence.



VACUUM-cup devices transfer blank to wrap-around machine which forms a four-walled box with a top overlap.

Before reading this article, take a good look at your typewriter. Is it vintage stock, or brand, spanking new? In any event—would you have been willing to pay up to 145% more for it?

Remington Rand is able to pass on to its customers a larger cost-savings because . . .

Typewriter parts are projection welded

COSTS ENTAILED in the production of early writing implements — when Mother Nature supplied all the parts —were a drop in the ocean compared to the economics of modern materials.

The ancient Egyptians were limited in their pen production only by the number of reeds they could gather from the Nile. Production cost: negligible.

The early settlers in this country had their quill supply honking in the barnyard and were limited in production only by the irascibility of any one goose. Production cost: again negligible.

Today, the typewriter has come to the fore as a modern writing implement—limited only by the number of people who want them. Production cost: *approximately 145% less than what it might be if joining methods other than welding were used.*

UNDERSIDE view of RR's Quiet-Riter typewriter shows the side-plate support *(boxed)* in position.

The typewriter, like so many appliances, machines and tools used in everyday living, is hardly ever conceived as a product of welding. (See *Welding in every way,* WELDING ENGINEER, September, p. 30.)

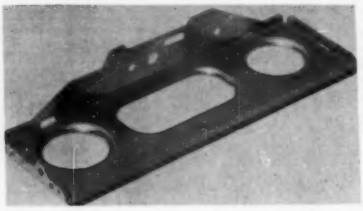
Remington Rand Div. of Sperry Rand Corp., however, has *always* incorporated resistance welding in the fabrication of its typewriters. Actually, the high production cost percentage quoted above is the estimated cost of RR's Quiet-Riter portable if no welding were used.

The company welds scores of parts for the three different kinds of typewriters it manufactures. The basic

FIG. 1—Right and left brackets *(below)* are positioned by the operator for welding to the side-plate support of the typewriter.

FIG. 2—The side-plate support is then placed on top of the right and left brackets, and the three-part unit is ready for welding.

FIG. 3—Final operation is the actual welding. The welded unit, when placed in the typewriter, will support the shift oscillator.



process, resistance welding, includes spot, projection and projection-ring welding methods.

Here are some examples of the cost savings provided by welding:

On one typewriter assembly, resistance welding of two parts was substituted for riveting. Production cost for the joining operation dropped from $1.98 per hundred to $1.38 per hundred, a reduction of 30.15%.

On another assembly, where projection-ring welding replaced riveting of small parts, production cost was reduced by about 20%. And wherever this resistance welding method replaced brazing, the reduction in cost was close to 30%.

Typical of these welded typewriter parts is a side-plate support with brackets used on the Remington portable. (See photographs 1, 2 and 3.) The side-plate support carries the two vertical brackets which, positioned underneath the machine, support the shift segment oscillator. (Plate thickness is 1/16 in.; bracket thickness, 3/32 in. A high-carbon steel is used for both.)

Joining of the plate and brackets is done with a projection welder rated at 75 kva. (Spot welding was formerly used, but because it was a slower process and required the attention of two welders on two machines, a change to projection welding was made.) There are a total of 22 welders of various sizes and makes used in the plant for production.

Primary current used in welding brackets to the side-plate support is 220 volts with a pulsation rate of 60 cycles. The secondary voltage at high tap is 5.5 volts; at low tap, 3.2 volts. The low tap setting is normally used and develops about 25,000 amp. Maximum short circuit current is 34,000 amp.

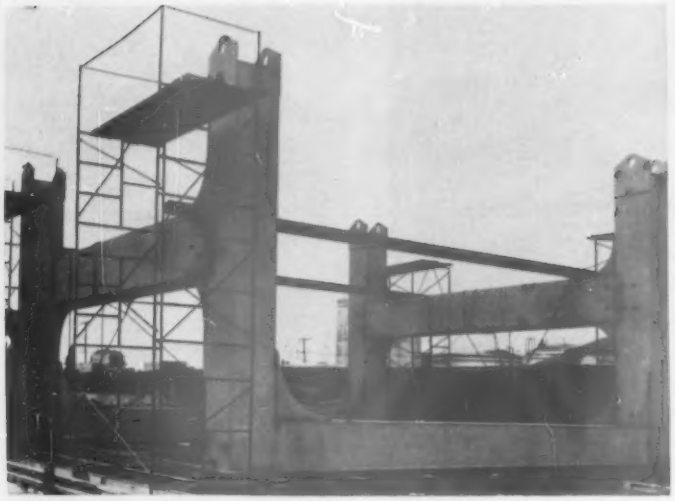
The machine settings for pulsation are: *squeeze time,* 18 cycles; *welding time,* 28 cycles; *hold time,* 10 cycles; and *off time,* 23 cycles. Heat control is 76% of the current.

Pressure to make the weld is applied through an air cylinder using 80-psi line pressure. Remington uses this method because of its high production rate—based on 204 pieces per hour, or one every 17.6 seconds. Valves are set for 500-psi holding and 650-psi return pressures.

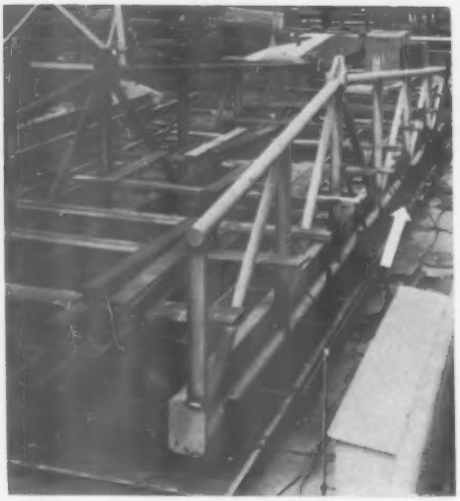
The upper and lower electrodes are copper, and are reinforced at the tips with copper-tungsten inserts. (Wear on electrode tips, which RR is successfully combating, is a critical factor in high production runs. Each time an electrode is replaced, time is often lost shaping the new tip faces to a proper contour. And before production can be resumed, new weld samples have to be made and tested.)

In order to obtain repeated slag-free welds, and to minimize wear on the electrode tips, all parts are washed in an alkaline solution and dried prior to welding.

Remington Rand has put welding to good use—providing a better product for its customers, as well as larger cost-savings.



BASE girders of crane were fabricated upside-down. Holes shown at top are for installation of railroad-type wheels. Dock rails hold crane so it can be moved to ship rather than moving ship to it. Portal beam clearance of 22½ ft assures trucks free movement through crane's legs.



WELDORS (arrow) work on section of 107-ft boom. Comparing weldors to boom depicts enormity of crane. Rectifiers and m-g welders were used when welding manually.

Another welded product saves a company hours and dollars

Loading crane vital cog in shipping firm's new time-saving system

ARTIST'S sketch of shore-to-ship loading crane in action. Loaded trailers are shown alongside empty one awaiting aluminum container on-way from ship. Crane can handle containers weighing 25 tons. Control system is in cabin at end of boom. Crane is in operation at Encinal Terminal, Alameda.

AN ALL-WELDED shore-to-ship loading crane made by Pacific Coast Engineering Co., Alameda, Calif., is saving Matson Navigation Co. hours and dollars.

The crane is part of the shipping firm's trans-Pacific "containerization" program planned to eliminate as many time-consuming handlings of cargo as possible. Cargo is loaded into aluminum containers 24 ft long, 8 ft wide and 8½ ft high at the manufacturer's warehouse, and is not touched again until it reaches its destination.

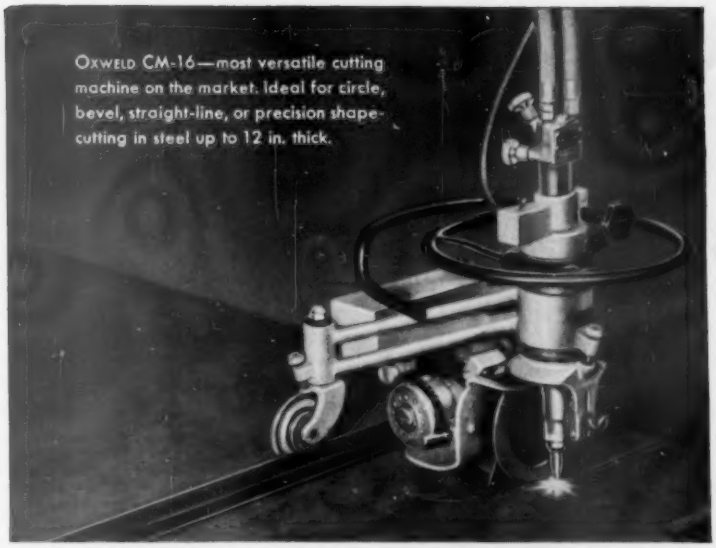
The containers are placed on flatbed trucks or railroad cars, taken to dockside, moved to the ship by the huge crane, and removed the same way at the voyage's end. From here they again travel by truck or rail to their final destination, and are unloaded.

The program not only eliminates numerous handlings, it also does away with dockside warehouses, cuts shipping and dockside time and results in a large reduction in operational costs.

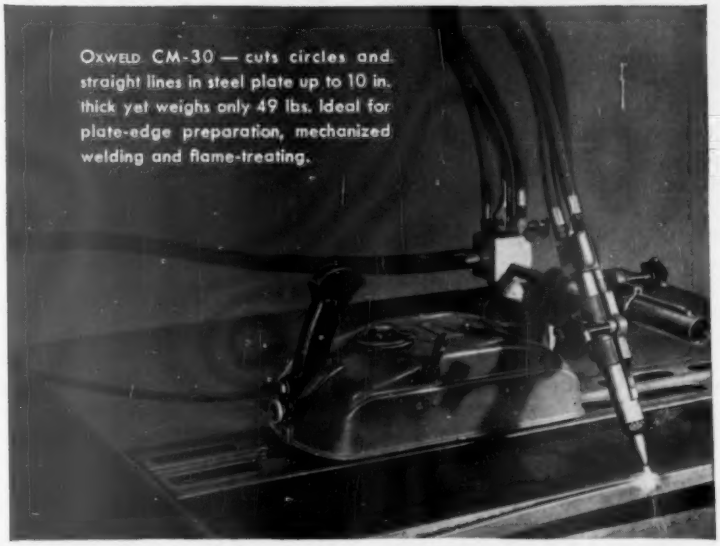
Manual metal arc, automatic and semiautomatic submerged-arc welding were used in the construction of the 118-ft crane, which has a 107-ft boom. Iron powder electrodes for manual welding in the flat and E6010 electrodes for vertical and overhead welding were needed. Hand welding required one pass. Electrode diameters ranged from 3/16 to ⅜ in.

No pre- or post-welding treatment was needed, though the heavier plate was beveled and some of the welds back-gouged.

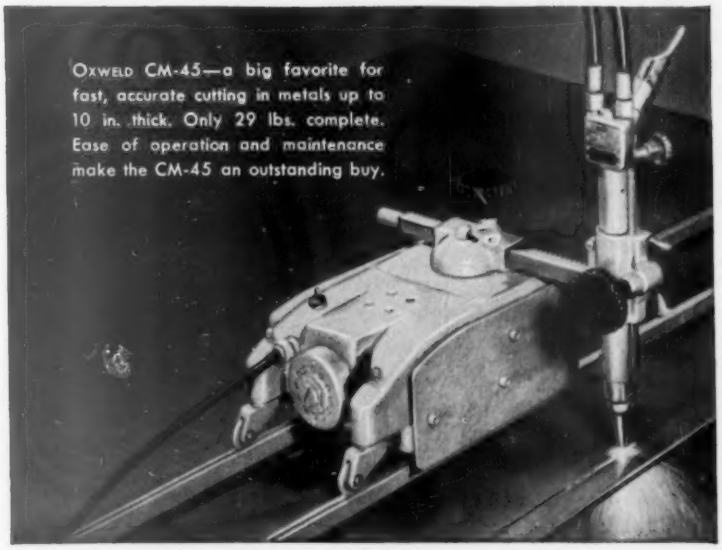
One of the outstanding features of the crane is its control system. A special transmitter shows the position of the container in relation to its desired position after it passes from the operator's view and into the ship's hold. Automatic selection of the position is available, and places the container within ¼ in. of its intended place.



OXWELD CM-16—most versatile cutting machine on the market. Ideal for circle, bevel, straight-line, or precision shape-cutting in steel up to 12 in. thick.



OXWELD CM-30 — cuts circles and straight lines in steel plate up to 10 in. thick yet weighs only 49 lbs. Ideal for plate-edge preparation, mechanized welding and flame-treating.



OXWELD CM-45—a big favorite for fast, accurate cutting in metals up to 10 in. thick. Only 29 lbs. complete. Ease of operation and maintenance make the CM-45 an outstanding buy.

cutting holes in production costs

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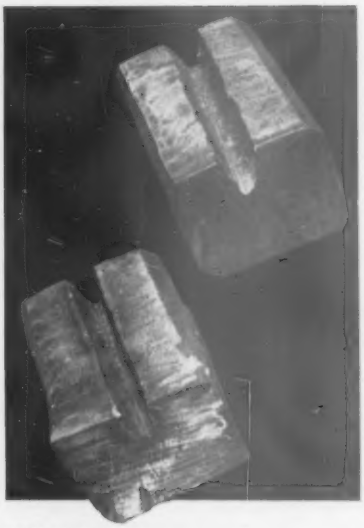

Which piece of 20 carbon steel was gouged in 26 minutes?

These two blocks of 20 carbon steel are 7 in. square and 8 in. long. The groove is 2¼ in. deep. The block on the right took 1¾ hours to chip out. The one on the left was gouged with an Arcair torch in 26 minutes — four times faster!

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A short, eventful history of pipelines

BENEATH AMERICA'S SOIL lies a network of throbbing veins. The pulse within them is oil. Steel tubing —188,000 miles of it—carries this lifeblood of industry. This many miles of oil pipeline is enough to girdle the earth seven times and is long enough to reach three-quarters of the way to the moon.

These amazing figures become even more astounding when we realize there were no oil pipelines in this country until 1862. It was in this year that J. L. Hutchings, a New Jerseyite, buried a 4-in. line made of wood, its joints held together with lead. The first time he put it into action his pumps jolted the seams apart.

In 1864, Samuel Van Syckle succeeded where Hutchings had failed. More conservative than his predecessor—and wiser—Van Syckle fabricated *his* pipe of iron and screwed all joints together. He swore no pump would shake it apart. And no pump did.

Although the pipeline was only 2 in. in diameter and five miles long, it soon was carrying 800 bbl of oil per day. Today, the nation's pipelines move over 10,000,000 bbl per day.

But this Jack-and-the-beanstalk growth did not go unopposed. State legislatures, in those early periods, blocked charters for their construction; railroads refused to grant right-of-ways across their tracks; teamsters tore pipes from the ground.

By 1920, however, pipelines were no longer considered upstarts—and welding was rapidly becoming *the* method of joining them. In fact, from 1952 to 1955, the rate of growth had climbed to 10,000 miles per day. The magnitude of such operations can be gauged by the fact that, during 1957 alone, $27 million was spent on welded pipe joints.

The improvement of pipelines can be attributed to the widespread adoption of welding. For years, Henry L. Doherty, founder of Cities Service Co., believed it was possible to use a light, large-diameter pipe of high-tensile strength to replace small-diameter pipe with thick walls, and so salvage billions of cubic feet of natural gas which was "flared" or burned as useless in the oil fields.

Doherty's belief became a reality in 1931 when a 960-mile, 24-in. pipe —20 in. larger than Hutching's— pushed natural gas from Texas to Chicago. Soon even greater distances were covered when the "Big Inch" and "Little Inch" stretched from Texas oil fields to the west coast and to the east coast.

Today's oilmen boast they can pipe a gallon of gasoline from Houston to Kansas City for less than it costs to send a postcard the same distance— a far cry from wooden pipes and lead joints.

ONE of school's 10 welding machines is used by student to practice day's lesson. Note number of welds made by students practicing on same pipe.

Canadian welding school conducted by Price-Poole

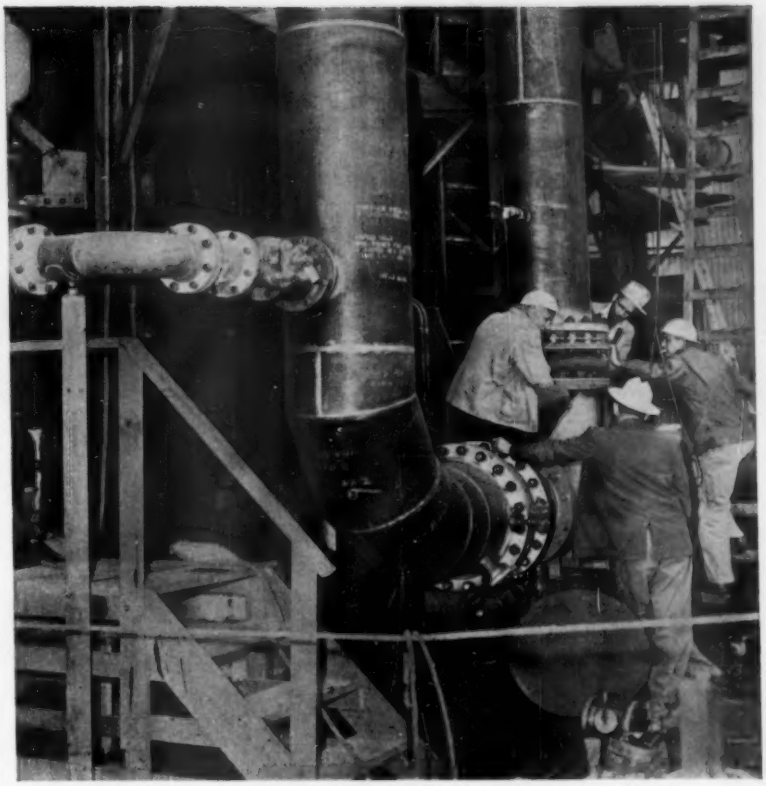
PRICE-POOLE found a way to get experienced pipeline weldors to help complete a 63-mile line of 30-in. diameter pipe in Ontario Province. Price-Poole opened a welding school in Huntsville, Ontario, last year and began training weldors the way the two companies wanted them trained.

The school was in session for eight weeks. Five of the 18 men enrolled completed the full 400-hour course. None of the students had any pipeline experience, but some were experienced shop weldors. Others had attended a six-week course at a welding school in Windsor.

Three men successfully passed the test at the completion of the Price-Poole course. Those who failed were given an opportunity to work as weldor's helpers and gain enough experience to pass the test next time.

The pipeline construction and school was handled jointly by H. C. Price Co., Ltd. and Poole Construction Co., Ltd., of Canada.

STUDENT learns to operate a cutting torch.



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REASON — because all weldments were fabricated from improved, "patented" Ampco Metal 8 alloy containing a new "additive" to provide extra protection against corrosion and erosion.

Also, all welds were made with Ampco-Trode 10 spooled wire and filler rod using the inert-gas processes to provide a deposit of matching composition and properties.

Ampco-Trode 10 electrodes and filler rod are very versatile. They are used to join a wide variety of copper-, iron- and nickel-base alloys, dissimilar metals, as well as for the overlay of bearing, wear- and corrosion-resistant surfaces.

Ask your Ampco field engineer about new, "patented" Ampco Metal grade 8 and Ampco-Trode 10. Or write for details. *Ampco Metal, Inc., Dept. 186A,* Milwaukee 46, Wisconsin.

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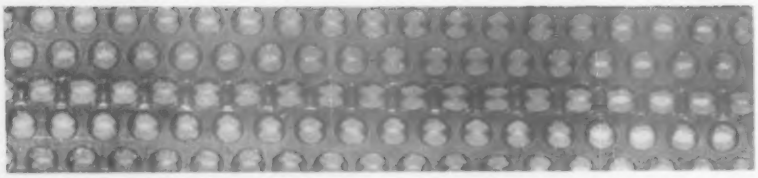


Fine mesh screen can now be Tig welded with a new set-up

WELDING CONTINUES to make more appearances in specialized fields in American industry. Its most recent debut: manufacturing of non-slip cloth covered with closely spaced, small neoprene protrusions.

Mass production techniques required neoprene to be applied by a rapidly rotating 0.015-in.-thick stainless steel cylinder containing 260 holes per sq in.

The problem: the cylinder, fabricated with a longitudinal lap joint, created unsightly "skips" in the protrusion pattern with every turn.

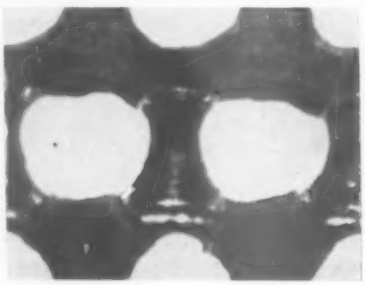
Airline Welding and Engineering, Hawthorne, Calif., solved the problem with a machine set-up designed to Tig butt-weld screen or perforated metal into flat sheet, cylinders and cones, or other regular shapes without altering hole shape, spacing or continuity.

In the first operation, the screen was sheared through the exact center of the hole line. The two pieces were then welded together. The new traverse diameters of the welded holes were measured to determine weld shrinkage. This measurement was then divided in half and the traverse radii increased by this amount. Thus, after shrinkage, the welded holes were identical in size to all others in the screen.

The screen was then formed into a cylinder shape, placed in a positioner and carefully micro-aligned so that the weld would be made on the low side of the shear tolerance.

Final welding was done with Tig, using argon gas, straight polarity d-c current at 8.75 volts, and one amp per 0.0001-in. material thickness. Welding speed was 14 ipm, using a 0.040-in. tungsten electrode tapering to a 0.015-in. point.

Airline longitudinal positioners and mandrels were used (the latter being interchangeable for various shapes and lengths). Two power-operated, level-seeking parallel banks of steel "fingers," with continuous copper gripper platens, positioned and clamped parts precisely to the mandrel backup bar.



SMALL?
This enlargement is really only 1/3 of a square inch of screen! Hole diameters are 0.040 in.

The backup bar was grooved to fit specified weld contour "drop-thru" for uniform bead width and was pierced with holes for inert-gas backing. Mandrels and hold-down devices operated together, providing an unusual form of chill shunt tooling to prevent burning, warping and excessive distortion.

Airline's welding set-up can join screen ranging between 0.005 and 0.063-in.-thick with hole spacing of not less than 0.010 in. and minimum hole diameters of 0.020 in. Weld width was held to a tolerance of ±0.010 in., while weld thickness was held to ±0.002 in. in 0.020-in.-thick base metal.

Stainless steel, aluminum and magnesium alloy, titanium and other pierced or unpierced metals from 0.003 to 0.500-in.-thick can be welded without any inclusions, cracks or laminations.

Side beam tracks are fitted on the machines for support of welding heads and carriages for maximum vertical and lateral accuracy. Ranging from 2 to 16 ft in length, these tracks have top and bottom ways machined to a surface finish equivalent to MU 32.

The tracks, supported at 6-ft intervals, provide smooth travel for welding equipment weighing up to 400 lb and assure arc length accuracy of 0.005 in.

After welding, the holes were inspected at the weld, and if found to be slightly undersize, were lightly roll planished to bring them to correct dimension.

The actual welding process, whereby each butted "bud" was fused with identical configuration, was made possible by the efficient chill shunt tooling and mandrels, accurate positioning, precision side-beam track and smooth, automatic travel of the welding head.

Should the geometry of the part call for an identical weld as thick as the parent metal, the shear is adjusted for an even smaller initial radius, and the part is then roll planished under higher pressures.

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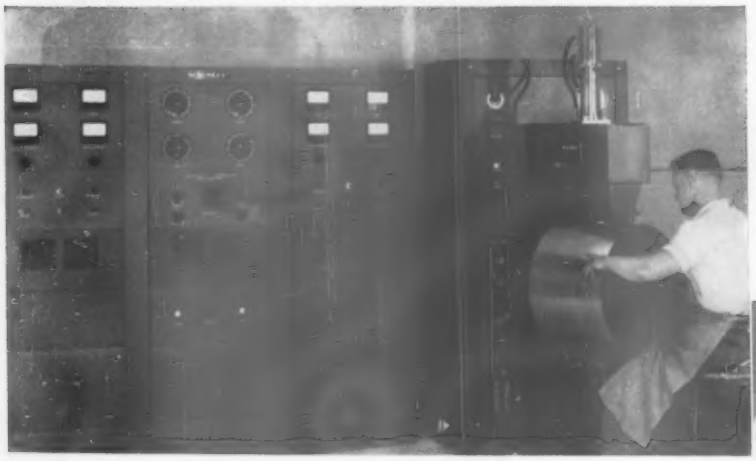


NEWEST ultrasonic welder *(left)* is 4000-watt unit shown splicing an aluminum cylinder with overlapping spot-type welds. Process also is used for soldering *(below)* and brazing.

Ultrasonic welding comes of age

Ping-ping . . . range! . . . mark! . . . *ping* . . . COMMENCE DEPTH CHARGE ATTACK.

This was the first use of ultrasonics: the detection and destruction of enemy submarines.

But today, sound waves and their resulting vibrations have been converted to a peace-time use, welding—thanks to the pioneering of Aeroprojects Inc., West Chester, Pa.

The company's subsidiary, Sonobond Corp., maintains a stable of ultrasonic welders ranging from a small 100-watt welder used to join fine wire and thin foil, to a large spot-type 4,000-watt welder. This latter welder was spotlighted at the company's open house last month commemorating its tenth anniversary.

A new addition to the Sonoweld line, the welder is reportedly capable of joining medium-heavy gage material (aluminum, copper) and thinner gage sheet metals and alloys (titanium, zirconium, molybdenum, Inconel).

The fast-growing welding process uses ultrasonic energy (high-intensity vibrational energy, usually but not necessarily at a frequency above audible range). A typical welding unit consists of a high frequency electrical generator, a transducer to convert this energy to mechanical vibration, and a coupler to transmit the vibration to the work area and apply it to the metal.

According to the company, ultrasonic welding can boast of the following advantages:

(1) Excellent joints in a great variety of metals and alloys normally difficult to weld.

(2) No current passes through the joint, so there is no arcing, spitting or sputtering.

(3) Since there is no fusion, there is no grain growth, brittleness or fatigue failure.

(4) Pressure-tight joints with efficiency of 90% or more have been obtained.

(5) Thin metal foil can be welded to itself, or to heavy materials.

(6) Low clamping forces are required with little external deformation as a result.

(7) Power requirements are low, *e.g.*, one machine with a 4 kva rating will do the same welding job as a 50 to 75 kva resistance welder.

(8) The process is far less complicated, some machines having only one knob for setting and/or adjusting. (This could be a possible labor cost-savings, since many plants regulate operator pay according to the machine's complexity.)

(9) Part cleaning is limited to degreasing, and anodized or insulated materials can be welded without removal of the protective coating.

As in any new development, there are disadvantages: the process is slower, requiring 1/10 to 1/20 more time; joints cannot be butt-welded presently.

However, the great adaptability of the process to thin gage, as well as heavy gage materials, outweighs the two disadvantages, which will probably be eliminated in the near future.

NATIONAL ELECTRIC

solves tough production problem of welding air-suspension brackets for 1958 cars

The new air suspension systems introduced on some 1958 cars, create not only a super-smooth ride for passengers . . . but many production problems for manufacturers. To help lick one of these problems . . . National Electric designed and built two new multi-station arc welders that perform 2 important operations on the structural members of the new systems.

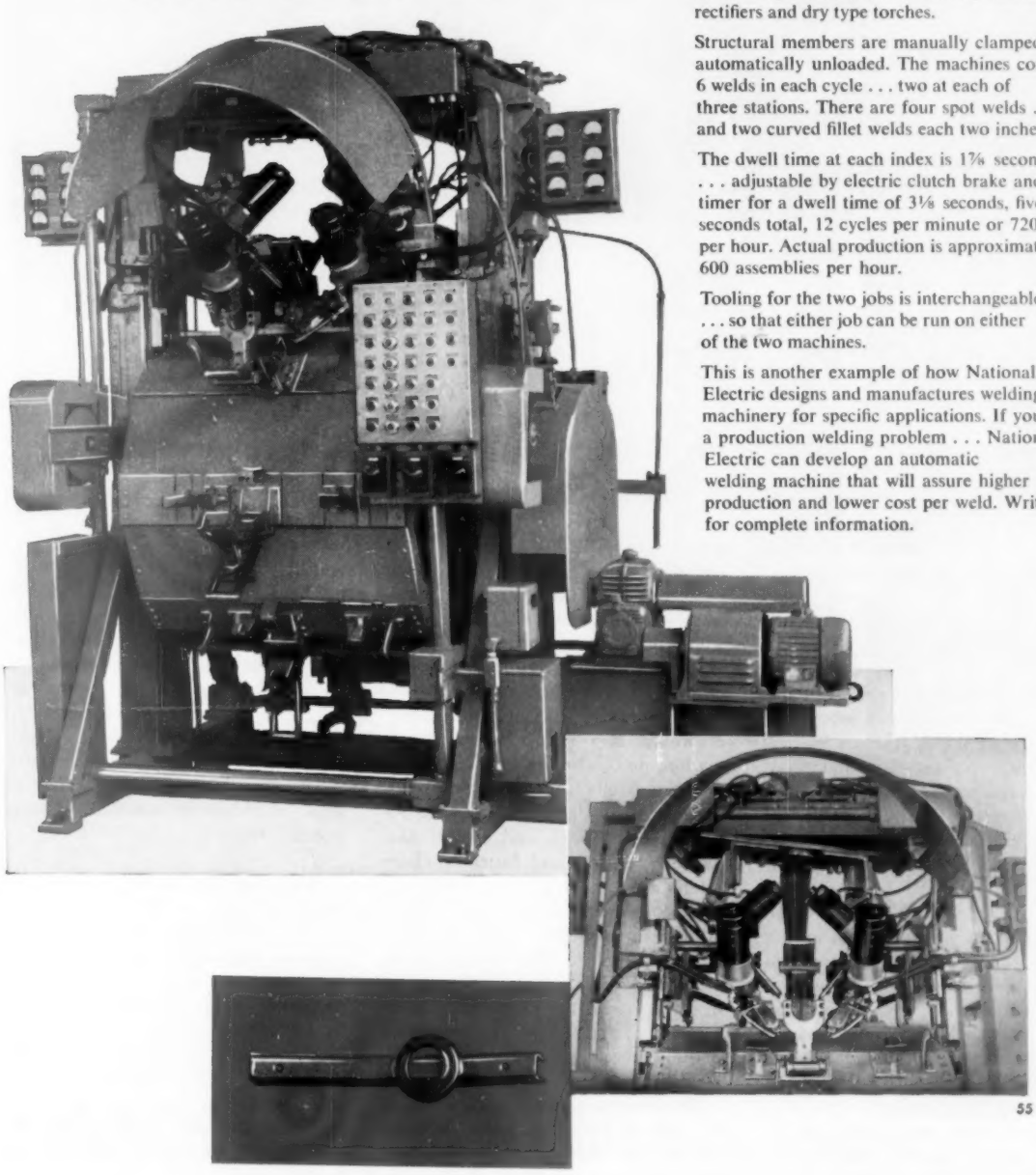
These 6-head, CO_2 arc welders incorporate a drum feed, 8-station Geneva Index, with 800 amp. rectifiers and dry type torches.

Structural members are manually clamped and automatically unloaded. The machines complete 6 welds in each cycle . . . two at each of three stations. There are four spot welds . . . and two curved fillet welds each two inches long.

The dwell time at each index is 1⅞ seconds . . . adjustable by electric clutch brake and timer for a dwell time of 3⅛ seconds, five seconds total, 12 cycles per minute or 720 cycles per hour. Actual production is approximately 600 assemblies per hour.

Tooling for the two jobs is interchangeable . . . so that either job can be run on either of the two machines.

This is another example of how National Electric designs and manufactures welding machinery for specific applications. If you have a production welding problem . . . National Electric can develop an automatic welding machine that will assure higher production and lower cost per weld. Write for complete information.



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NATIONAL ELECTRIC WELDING MACHINES CO.

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25 YEARS EXPERIENCE DESIGNING AND BUILDING: SPECIAL & STANDARD • AIR • HYDRAULIC • MOTOR DRIVEN • SPOT • PROJECTION • SEAM • BUTT • FLASH • RESISTANCE WELDERS • PRODUCTION FIXTURES FOR ALL TYPES OF AUTOMATIC ARC WELDING.

ON a tube production line, this Thermatool welder monopolizes little space, accomplishes much.

Theory pays off on h-f tube welder

WHENEVER AN ENGINEER must plan a tube welding set-up, three things are generally uppermost in his mind:

(1) how to position strip edges so they are parallel to each other as the sheets travel through the mill;

(2) how to heat the seam's interfaces so fusion results when they are pressed together;

(3) how much transverse pressure must be applied to gain a homogeneous bond between the interfaces.

Fortunately, the first and third problems are mechanical and have already been solved by tube mill fabricators. And it appears the second problem may be approaching a solution.

New Rochelle (N. Y.) Tool Corp. believes their new Thermatool welder provides the answer. For corroboration of their claim, they point to Republic Steel (which has used and studied the machine for two years), to Aluminum Co. of Canada, Reynolds Metal, James Steel & Tube, and J.F.D. Mfg. Co.

This machine, they state, allows welding speeds greater than 250 ft per minute on strips of hot or cold rolled steel, stainless steel, copper, brass, aluminum—or any ferrous or nonferrous metal—as they are fed through a standard forming mill. On thin wall tubing like that used in tin cans, they continue, speeds in excess of 1,000 fpm have been reached.

These speeds are made possible by the patient development of a theory. The theory was that heat energy should be concentrated in the weld area and only in the weld area. Such concentration, it was believed, would prove beneficial in many ways.

First, it would minimize harmful effects on metallurgical characteristics in areas adjacent to the weld. It would also reduce metal deformation and lower energy demands proportionately for any given welding speed. Furthermore, it would reduce welding flash and spatter and improve bending and flattening characteristics.

Now knowing what they wanted to achieve, engineers began working toward that goal. The answer lay in the "proximity effect" commonly associated with the path of high-frequency current flow in industrial heating processes.

Because current always takes the path of least impedance, it stays on the tube edges since the h-f current raises the reactance of the path around the tube to a point where essentially all current passes through the welding point. This efficient use of current avoids unnecessary heating of the rest of the tube.

Two copper shoes are mounted directly in front of the pressure rollers, which force the tube interfaces together. The shoes straddle the joint and are connected to the output terminals of a high-frequency transformer energized by a specially designed generator. High frequency current flows out of one of these contacts and back through the other, seeking the path of least impedance.

The advantage of this is that all electrical energy is concentrated on the strip's interfaces before the welding point on the apparatus is reached. No current flows around the tube or into neighboring sections. Consequently, there is no wasted heat.

All this is accomplished by high-frequency current that builds to almost 500,000 cycles per second —permitting higher welding speeds and thereby allowing metals to be resistance welded which could not be so welded before. In fact, welding rates are dependent only upon the metal's wall thickness (the machine will join materials up to ½ in.) and the speed with which the mill can deliver stock to the welding head.

Welding itself reportedly lays only a small inside bead. There is said to be practically no inside spatter, usually caused by current fluctuations, so there are few rejections due to dirty interior surfaces. But any

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Actual Field records show up to 25% increase in cutting efficiency and cleaning room production with Manhattan Reinforced Cut-Off Wheels. That's because these wheels are specially designed to take the abuse of heavy cutting in foundry operations far beyond the limits of conventional cut-off wheels. Manhattan Reinforced Cut-Off Wheels are reinforced *two* ways. First, special fibers in Manhattan's bond increase by 50% the wheel's strength to withstand destruction by centrifugal force. In addition, super-strength synthetic lateral reinforcement gives a degree of resistance to side-strain not possible with ordinary wheels. Double reinforcement adds up to double safety and protection from breakage, too!

Let a Manhattan sales engineer show you how to increase production efficiency . . . get "More Use Per Dollar" at your shop with Manhattan Reinforced Cut-Off Wheels and other types of Manhattan high speed, heavy duty wheels.

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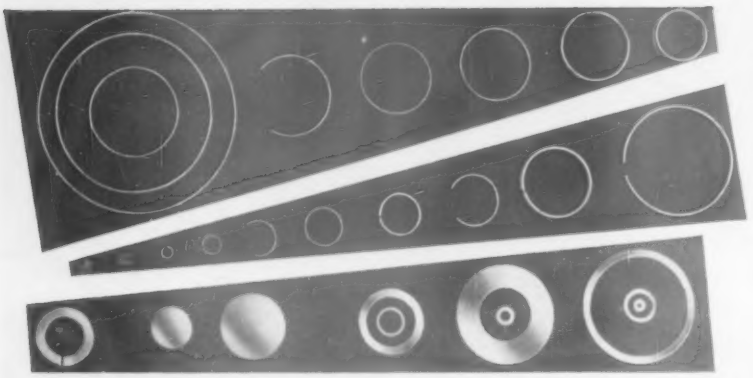

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GB *PRE-FORMED* Silver Brazing Alloys are available in the size and shape your job requires. Pre-formed shapes, like those shown, are designed for the joint. They assure strong, safe connections with a measured, minimum amount of alloy to save you time and money.

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inner or outer beads that must be scarfed can be cleaned without reducing operational speed. Reprocessing delays, the company states, are almost nonexistent.

Only wall thickness limits the size tubing which can be welded in this way. The largest tubing can be run as swiftly as the smallest, assuming both have the same wall thickness.

At an early demonstration of the unit, it was set to weld 2-in. OD tubing with an 0.037-in. wall thickness. Coils of aluminum alloy, hot and cold rolled steel, stainless steel, brass and copper were welded in turn with only slight adjustments of the electrical controls as stock was changed over.

The device can be adapted to any tube mill and head. Transformer and generator will fit a floor space of approximately 3 by 7 ft and 7 ft high between the last set of forming rolls and closing rolls. Installation in cold forming mills for butt-seam and locked-joint tubing is said to present no major conversion problems.

In addition to these joining techniques, the h-f welder can also be applied to square, rectangular, odd-shaped pieces, or used to weld strips together. Changing the machine to fit varied size tubing to be welded requires only adding additional equipment.

Fabricators who bend or form tubing welded in this way need not position the weld area, the company says. This eliminates the necessity of using extruded tubing in cases formerly demanding it, or for which it was recommended.

But how does the h-f welder work on an actual job? The firm likes to tell of J.F.D. Mfg. Co., an antenna manufacturer, that found warehousing and maintaining the two million lb of aluminum tubing it needed each year to be a major headache.

Convinced that the answer to this problem was the installation of one of the new machines, the company now makes its own tubing from 2,000 ft rolls of strip, which take little space in comparison to the tubing previously used. Since the machine is adjustable to different size stock, a supply is produced as needed and in the sizes to be used. Savings? Twenty-three per cent in the first year.

FIRE prevention and protection in welding and cutting operations

by **Roger Cholin***

FIRE SAFETY in the welding industry is a two-headed coin —and you can't lose when using it.

On the one side is fire prevention through proper observance of safety standards; on the other, correct protection procedures, if and when a fire does start.

With or without justification, welding and flame-cutting have been pictured as culprits in some of the nation's most spectacular fires: *e.g.*, GM's $70-million fire at Livonia, and the French Line's *Normandie* at her New York pier. Nine large fires during 1956 alone were laid at welding's door.

Almost without exception, the welding or cutting operations held responsible in these cases were being performed by experienced contractors, or by skilled employees of the plant. So the obvious lack of preventive measures and practices can only indicate that fire hazards are not fully recognized as such.

Admittedly, there are times when a completely fire-safe situation is impossible to attain. This is particularly true when maintenance work must be carried out in cluttered areas.

Fires seldom result from direct contact with the welding flame or arc, but rather from combustible materials readily ignited by sparks, which can travel up to 30 ft, molten slag dropping from a cutting operation, or pieces of hot metal cut from a heated member.

Most of these fires result from use of portable equipment, since welding done as a regular part of a production process is almost always well regulated and controlled.

On the other side of the fire-safety coin is protection after a fire has begun. Lack of proper equipment, or its delayed or improper use, has frequently permitted small fires to develop into uncontrolled blazes.

A hooded weldor concentrating on his job cannot readily detect fires. Thus, a fire watcher with one or more extinguishers should stand by at all times—not only during welding or cutting operations, but also during work breaks, lunch hours, and for at least 30 minutes after work has stopped for the day. (Cutting sparks may die out in seconds, but combustible materials can smolder without notice for some time before bursting into flame.)

Selection of fire protection equipment depends on the nature of fire hazards and the character of combustible materials.

Class A fires involve ordinary combustibles, *i.e.*, wood, paper or fabric, and require the cooling and quenching effects of water. (Chemical mediums can be used if the fire is in its early stages.)

Class B fires occur in flammable liquids—thus water

TIME exposure of welding sparks indicates the extent of travel and concentration, emphasizing the need for fire prevention and protection.

*Fire protection engineer, Safety First Corp., Elmsford, N. Y.

NINE RULES OF SAFETY

Whenever possible, move welding and flame-cutting jobs to a safe location.

Work should never be permitted near loose combustibles. Safe distances are: 15 ft for gas welding; 25 ft for gas cutting; 25 to 30 ft for arc welding, and 30 to 35 ft for arc cutting. (If combustibles cannot be removed, metal shields or asbestos curtains should be used as coverings. Curtains must be weighted to prevent sparks and hot slag from rolling under them.)

If possible, work on wooden floors or near wooden construction should not be authorized. If unavoidable, floors should be swept, wet down and covered with metal or a sand pan where sparks are likely to fall.

Openings to adjoining rooms or to floors above or below should be closed. All doorways, open or broken windows, floor cracks, pipe holes and ducts, tanks and drip troughs must be either closed or shielded.

No work should be done inside or near rooms where flammable liquids or vapors have been used until the area is thoroughly cleaned and all openings are safely closed.

Welding or cutting on equipment that contains or has contained any flammable substance should not be allowed until the container is thoroughly cleaned.

When arc welding, observe all usual precautions against short circuits and overheating. In gas welding and cutting, follow established rules for gas systems and for handling gas cylinders. Be sure equipment, especially hoses, is in good condition.

Obtain authorization from owners or responsible officers before cutting or welding in areas not designated for such work. Ask about hazards which may not be apparent.

Appoint someone to be responsible for the safety of cutting and welding operations, and institute a system of written permits and routine inspection after completion of all operations.

FIRE hazards in shops are guarded against while arc-welding horse-race starting gate. Since any fire developing would be a Class C type, a dry chemical unit is kept on hand.

will only scatter the burning materials and spread the fire. Dry chemical, carbon dioxide and vaporizing liquid extinguishers (carbon tetrachloride) are approved for this type.

Class C fires center around electrical lines or equipment, so water would only cause electrical shock by conduction. Extinguishers approved for Class B fires can be used for this type also, since the extinguishing mediums are non-conductors. (A Class B extinguisher is recommended for most operations, since it can temporarily control a Class A fire and can also be used effectively on both Class B and C fires.)

Of the three extinguishers approved for Class B and C fires, dry chemical types are favored, as can be seen from the following comparison. A 5-lb dry chemical extinguisher is rated at 4-B:C (a testing laboratory measure of fire fighting efficiency). On the other hand, a one-quart carbon tetrachloride extinguisher is rated at ½-B:C, eight times less than the dry chemical unit. Carbon dioxide extinguishers in 5-lb sizes are rated at 1-B:C, four times less efficient.

Some other advantages of the dry chemical powder are: *(1)* simplicity of operation; *(2)* powder ejection up to 25 ft and more, depending on gas pressure; *(3)* good characteristics (*e.g.*, insulation of the operator from the fire's heat; it is not toxic, abrasive or corrosive, and it is the only medium other than water that can be used safely on a person whose clothing is on fire); *(4)* prevention of fire flash-back, and *(5)* easy removal of powder.

Through adequate and proper fire prevention methods —requiring only a few extra minutes—and the proper fire protection procedures and equipment, most welding and cutting fires can be eliminated.

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

Completely automatic welding...guided by hand with the "Mechanized Squirt Welder"

Here's how you can get the speed and sureness of automatic welding . . . plus portability and versatility never before heard of in submerged arc welding.

Mechanized gun is propelled at any preset speed while electrode and flux are fed from an all day supply on the compact, portable control unit.

- Accurately controlled speeds from 1 to 70 inches per minute.
- Flux and wire supplies allow many hours of continuous welding.
- Guides in any direction without fixtures.
- Deep penetration of submerged arc welding.
- Easy to make beautiful welds.
- High operator appeal—light gun, no helmet.

TRIGGER—*Single trigger starts and stops flux flow, wire feed, and welding current.*

SPEED CONTROL AND REVERSING SWITCH—*Speed control dial calibrated in inches per minute. Can be changed while welding. Reversing switch determines direction of travel.*

TRAVEL MOTOR AND DRIVE WHEEL—*Propels gun in any direction at desired speed.*

ELECTRODE—(5/32" or 3/16")—*Feeds continuously from 60 lb. coil in control unit through extra flexible cable.*

MOTOR MOUNT—*Travel motor easily adjusted up or down to control flux coverage and rotated around the gun to change travel direction. Control wire coupling disconnects for quick removal of entire travel mechanism for manual operation.*

FLUX—*Granular flux feeds through tube from tank on control unit to small reservoir on gun. Flows from gun by gravity as needed.*

PORTABLE CONTROL UNIT (*not shown*)—*Contains arc voltage and inching speed controls as well as meters for welding current and voltage. Unit also mounts 60 lb. coil of electrode and tank for over 100 lbs. of flux. Entire control system operates on 115 volt AC power.*

The World's Largest Manufacturer of Arc Welding Equipment

LINCOLN

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Publishing costs have skyrocketed during recent years—to such an extent that it is no longer possible to continue the prevailing bargain subscription rates for WELDING ENGINEER.

In view of this, rates for the two and three-year subscriptions (which have been in effect for many years) will come to an end on Feb. 28, 1959.

Until then, new and renewal subscriptions will be accepted at the current rates of 2 years for $4 or 3 years for $5. After March 1, 1959, subscription prices for WELDING ENGINEER, the world's pioneer welding publication, will be:

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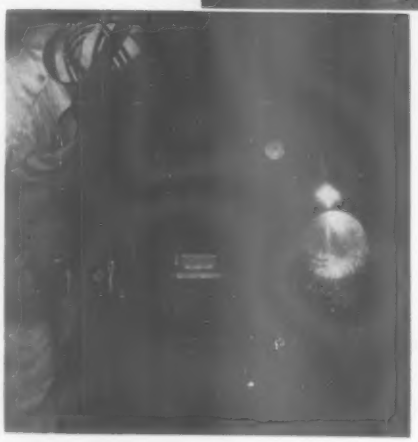
Morton Grove, Illinois

SUBMERGED-arc welding machine makes girth weld in 18-in.-diameter chrome-moly alloy steel pipe. Weld requires minimum post-weld finishing.



FIXED Tig cutting torch makes slant cut in 6-in.-diameter, ¼-in. stainless steel pipe at a speed of 40 ipm.

Welding—cutting team triples speed of pipe fabrication

TIG AND submerged-arc welding, plus Tig cutting, have increased pipe fabrication speed 300% at the Houston plant of Houston Pipe & Steel Co.

The manual metal-arc welding equipment formerly used in the manufacture of this pipe for oil refinery use was displaced by this topflight welding and cutting team. Linde Co. provided the new equipment.

The Tig torch makes one-pass root welds in chrome-moly alloy steel pipe, and the submerged-arc unit then completes the circumferential joint three times faster than the manual method it replaced. A current of 750 amps, d-c straight polarity is used for the second pass.

Smooth, inclusion-free welds made by these two methods have eliminated costly rejects and repairs which frequently occurred with the previous process.

To further cut costs and time, a manual Tig cutting torch was put to a mechanized use that eliminates machine-tool cutting operations in the production of stainless steel pipes. Slant cuts for mitered and saddle joints are made at speeds of 40 in. per minute as the pipe turns on rolls under the stationary torch.

Wear-O-Matic
WIRE FEED UNIT
AWARDED
SILVER MEDAL
In the 7th International Inventors Exhibition

The Wear-O-Matic Wire Feed Unit for semi-automatic hard surfacing applications was awarded the distinction of a silver medal award by an international panel of jurors at the 7th international inventors exhibit held in Brussels in conjunction with the World's Fair. Entered in the class for Industrial Processes and Machines, the Wear-O-Matic unit was the only American invention in the field of welding to receive such a distinction.

The simplicity of design, uniqueness of wire feed and wire handling, and potential economy to the user were important factors contributing to the decision of the jury. These same factors are responsible for a more important distinction—ACCEPTANCE—awarded by cost conscious, profit minded welding and maintenance shops all over the free world.

The advantages of the Wear-O-Matic Process so readily apparent to the experts, were designed to improve the efficiency of your hard surfacing operations. For complete details on the Wear-O-Matic Process and other hard surfacing materials, write, Alloy Rods Company, P. O. Box 1828, York, Pa. Request Bulletin HS-102.

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Dynamite for explosive joining

Question:

I have recently heard rumors of a metal-joining method that employs some type of explosive. Is there actually such a process, and if so, just how does it work?

Answer:

There is an explosive-joining method employing dynamite, and it is now being used by a firm fabricating aircraft and missiles.

This company's engineers originally developed the process to form metals into intricate shapes which could not be achieved on any known forming machine. The explosive technique is still used principally for shaping metals, though later development has proved it capable of joining, embossing and inlaying.

A report by the Aircraft Industries Association of America states that the idea for the new method is based on knowledge gained from wartime explosions. Violent underwater blasts from mines and torpedoes—and the strange effect they had on metals—were thoroughly studied by ship designers and engineers.

These men found instances of metal deformation that exceeded known limits of elongation; they also saw tough alloys shaped over and around softer metals. What they learned from these observations provided the groundwork for the cold-welding work now in progress.

Metals to be formed are placed over basic work forms, and may or may not be submerged in water. Some researchers feel that water gives a concentrated application of shock waves produced by the explosion; others feel that immersion in water is unnecessary.

Metals to be welded are positioned for the explosion that may or may not fuse joint surfaces. By carefully regulating the amount of dynamite, researchers have been able to achieve complete fusion as well as a simple bond. One east coast firm, for example, has experimentally bonded corrosion-resistant liners into tubes that will carry acids.

The possibilities of explosive forming and welding, as viewed by those now experimenting with the process, are extensive. The process can be applied to similar and dissimilar metals, with particular emphasis on aluminum and stainless steel.

Watch for a comprehensive report by WELDING ENGINEER on the explosive-welding process in the near future.

Question:

The company I work for has just installed some vats for dip brazing. Previously, we used torches for our work on aluminum and I wonder if we are going to get good results with this new method.

Answer:

The dip and furnace brazing processes normally are used when complex parts must be joined and torches can't do the job quickly or effectively. This is probably the case with your firm, and if certain important rules are observed, your dip-brazed assemblies will be highly satisfactory.

Briefly, these rules govern the temperature of molten flux in the vats, cleaning and preheating of parts, proper joint design and alloy placement, and good parts fixturing.

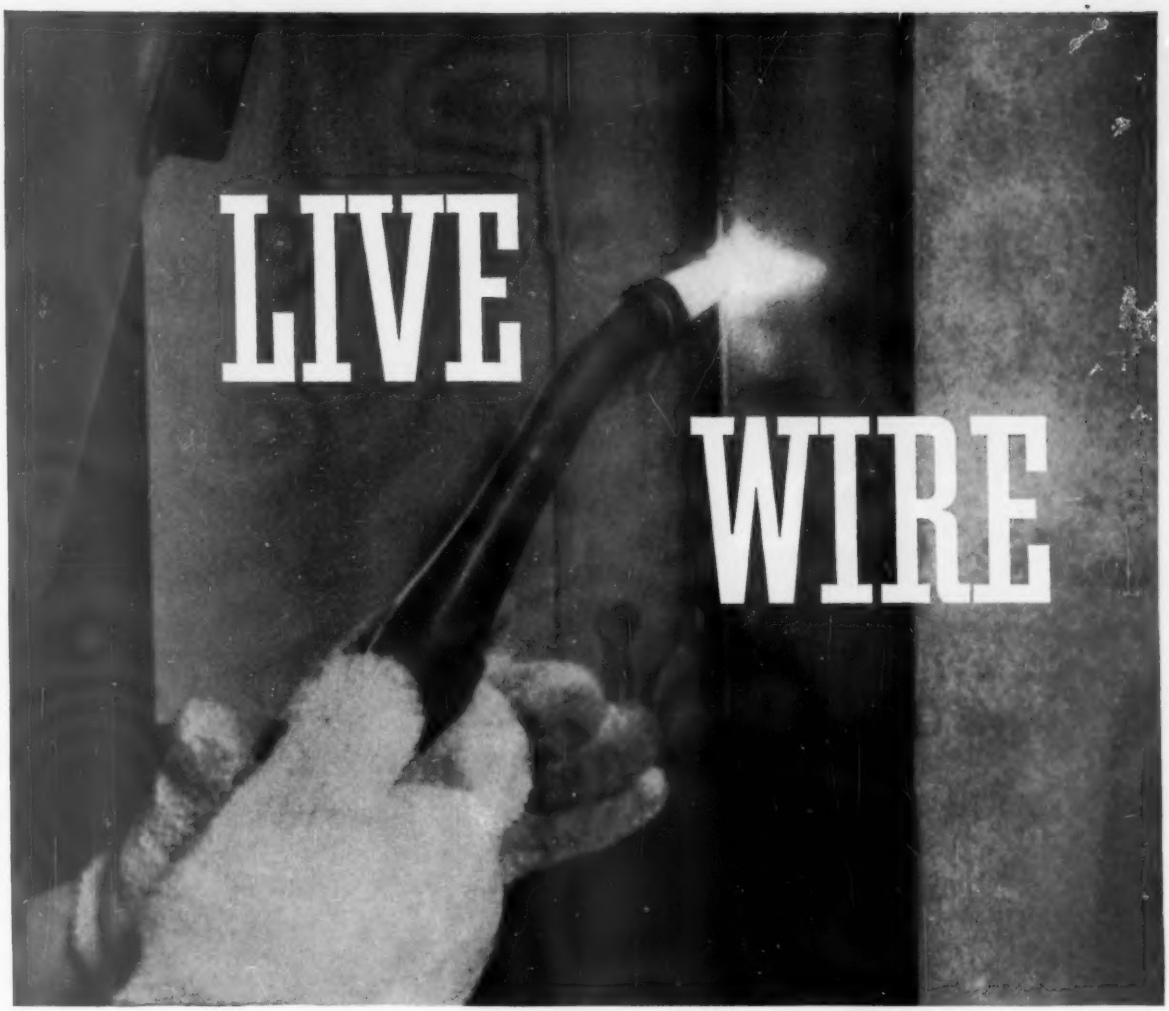
A good run-down of general procedure for dip brazing aluminum is this one, published as a fact sheet by Meridian Metalcraft, Inc., of Whittier, Calif.

(1) Degrease unassembled parts; *(2)* immerse parts in caustic bath; *(3)* rinse; *(4)* immerse in neutralizer; *(5)* rinse; *(6)* immerse in acid solution; *(7)* rinse; *(8)* assemble; *(9)* preheat assembly slowly and uniformly to 1,000 F; *(10)* immerse in heated flux for a period of from 45 seconds to 2 minutes; *(11)* air cool; *(12)* immerse in 212-F water; *(13)* rinse; *(14)* neutralize in acid; *(15)* rinse; *(16)* dichromate and nitric acid dip; *(17)* rinse.

Obviously, steps 1 through 7 and 12 through 17 indicate that cleanliness before and after brazing is crucial. Care must also be taken in preheating: parts that are cold, or are insufficiently heated, may suffer distortion due to thermal shock when they are placed in the molten flux bath. Preheating also ensures a dry assembly: moisture can cause the molten material to sputter and throw parts out of alignment.

Meridian concludes its fact sheet by pointing out that a dip-brazed joint in a correctly designed aluminum assembly will be from 80% to 100% as strong as the parent metal.

The Editors will make every effort to answer all questions submitted to this department. If you have a question concerning welding or related processes—or a tip you would like to pass along to other readers—send it to *The Welding Clinic*.



New design in Sigma hand welding torches

Here is a new, lightweight torch—only 16 ounces—for manually welding light-gage steels. Sigma ST-2 welds in all positions with no change in control or current settings. Welds .030- to .100-in. sheet, using low-voltage short-arc technique with .020- and .030-in. hard-drawn wire. For 200 amp continuous service, a-c or d-c.

Balanced design makes handling easy. Service lines enter through rear of handle—a convenience in cramped quarters. Start-stop switch on handle, easy to reach. Nozzle has a 60° curve for maximum weld visibility.

Sigma ST-2 makes high-quality welds at high speed. Seams require no cleaning . . . distortion is at a minimum. Inert gas shielding is economical. Low flow rate—only 10 cu. ft. or less per hour—means even more savings.

Call your nearest LINDE office today for a demonstration of this new Sigma ST-2 torch! Or write Dept. WE-1, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

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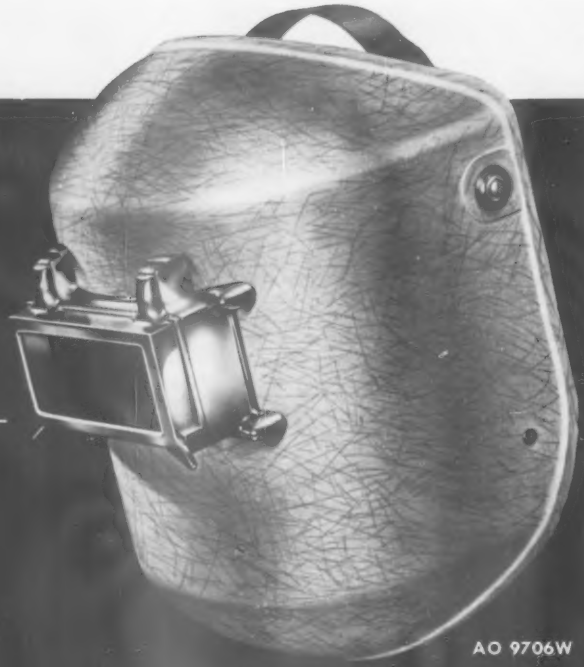
COOL
Over the Head...

COOL
Over the Eye Area



AO 9706W

AO's Radiant Heat Reflecting WELD-COOL HELMET with Aluminized Cover Plate

A comfortable welder is a better welder! This helmet reflects 70% of radiant heat from its white exterior . . . our 168AL plastic cover plate provides additional coolness in the eye area. Rear, "radio dial" adjustment knob locks when set for correct head size. Non-warping, moisture resistant, fiber glass shell—can be used indoors or out. Particularly recommended for gas shielded arc welding. Many other features.

AO 486A WELDERS' GOGGLE. New. Frame is soft, pliable, comfortable vinylite with a deeper cup and *better fit over the face and over all types of spectacles and* ℞ *Safety Glasses.* New nylon black adapter will not buckle or shrink with heat. Fitted with standard 50mm. rd. Noviweld or Filterweld lenses, shades 3, 4, 5, 6. Hardened lenses if desired. Recommended for acetylene welding, cutting, burning, brazing.

AO R5056 RESPIRATOR. Here's the respirator for all dusts not significantly more toxic than lead, pneumoconiosis-producing mists, chromic acid mist *and metal fumes not significantly more toxic than lead* such as produced in welding, burning or any operations where metals are heated to their melting point. Bureau of Mines Approval 2163.

AO 9X503. Whether it's gas or electric welding or burning this one-piece back, chrome leather glove with heavy black lining fills the bill. It's *very* serviceable hand protection. One-piece palm. Full leather cuff. Lining provides rigidity. All vulnerable seams welted.

See your nearest AO Safety Products Representative or write for literature.

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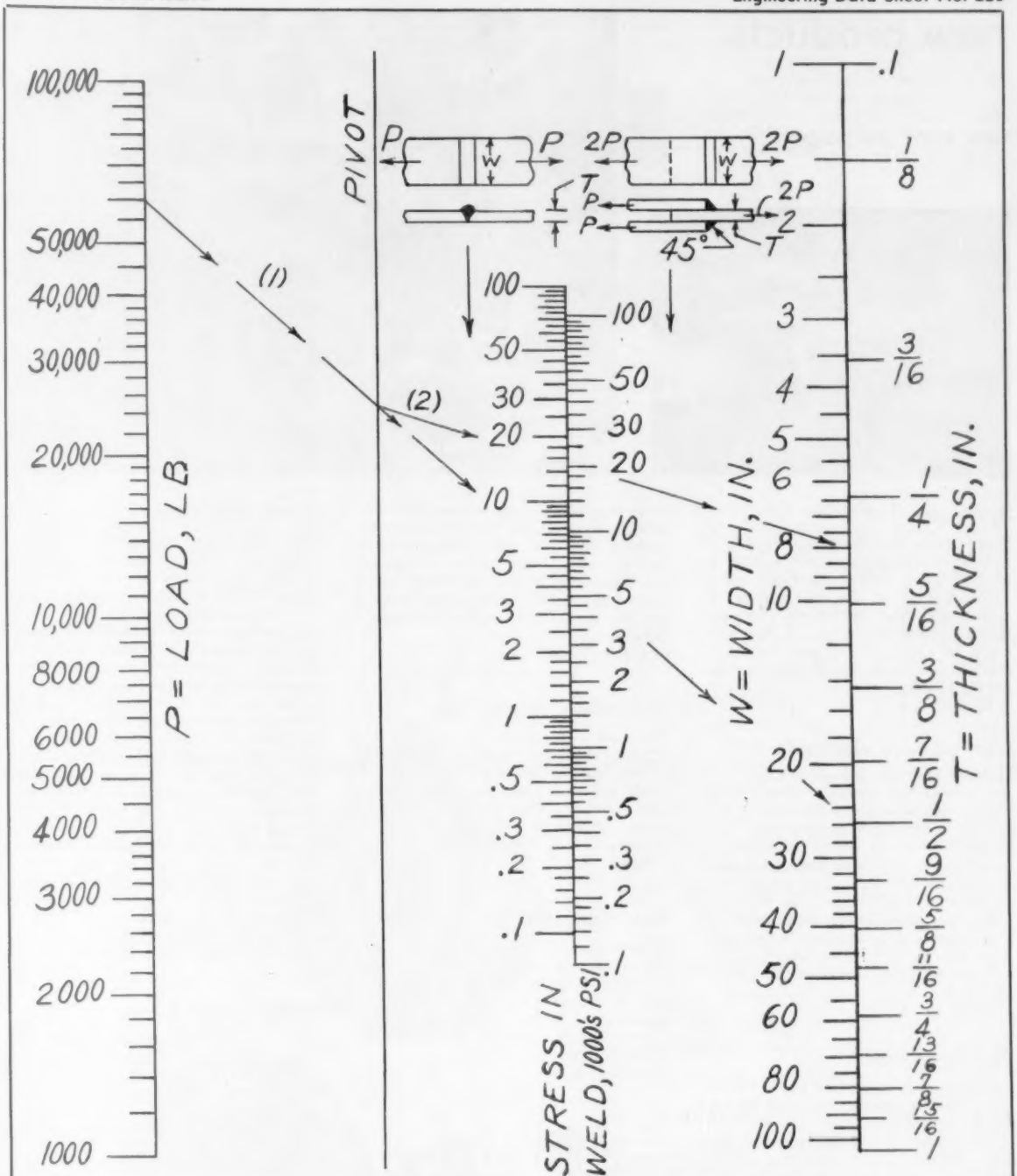


COMPUTING STRESS IN WELDS

For office or field use, this chart makes it easy for you to compute stresses in welds used for two common joint types. It is based on the equation: S = P/TW and S = 1.414 P/TW, where P = pull or load applied to joint (lb); T = weld size or plate thickness (in.); W = weld length or plate width (in.).

Note that in all cases, plate thickness is assumed equal to weld size and plate width is assumed equal to weld length.

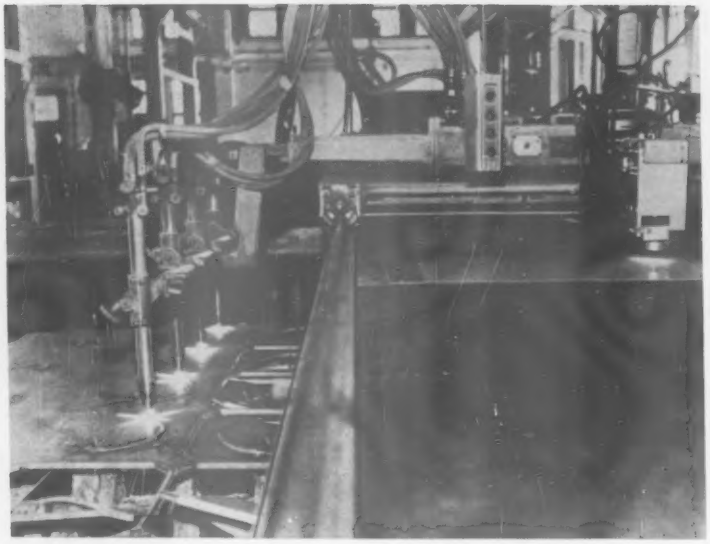
Use the chart like this . . .

Example: Determine stress in welds in two joints sketched above if the load is 60,000 lb; plate thickness is ½ in., and plate width 8 in.

Solution: Enter chart on left at amount of load *(60,000 lb)* and draw straight line *(1)* through plate thickness (½ in.) or weld size on the right. From intersection with pivot, draw a straight line *(2)* through plate width or weld length *(8 in.)* on the right. At intersection with central scale, read stress in weld as 15,000 and 21,000 psi, respectively.

new products . . .

use card on page 89



Spray-powder

SPRAY-powder material permits hardfacing with sprayed tungsten carbide at high deposit efficiency. Coating speeds are 110 to 150 sq ft per hour. Any thickness may be applied and then torch-fused. Minimum finishing operations are needed. New process is for application on parts subject to extreme wear conditions. *Metallizing Engineering Co., Inc.*

Circle No. 1

Iron powder electrode

MANGJET electrode is said to reduce cost and provide easy operation when welding 12-14% manganese steels. Electrode is suitable for building-up manganese steel hardfacing deposits on either manganese or carbon steels. The low-hydrogen electrode is used with both a-c and d-c welding machines. It is available in 5/32, 3/16 and ¼-in. sizes. Deposits are manganese steel with copper and molybdenum for strength. Joints can be torch cut on repetitive jobs, such as replacing dipper teeth. *Lincoln Electric Co.*

Circle No. 2

Plastic cement

NICROBRAZ cement, a liquid plastic vehicle and binder for applying powdered brazing alloys, comes in six viscosities, 250, 150, 35, 11, 8.8 and 8.2. It can be mixed with any powdered brazing alloy and applied with brush, eye-dropper, etc. Cement volatilizes completely between 500 and 600 F, leaving no residue or ash. Brazing alloy remains after volatilization, causing alloy to coalesce until brazing temperature is reached. *Wall Colmonoy Corp.*

Circle No. 3

Compressor system

TENDAMATIC, an automatic compressor control system, supervises and checks compressor operation and gives warnings if something goes wrong. Air pressures, temperatures, lubricating oil pressure, float level in condensate trap and cylinder lubricator operations are checked, says manufacturer. Audible and visible warnings indicate when something goes wrong. If machine is not stopped, automatic switch shuts it down. Tendamatic can be supplied for 100 to 750 amp machines. *Ingersoll-Rand Co.*

Circle No. 4

Eye safety display kit

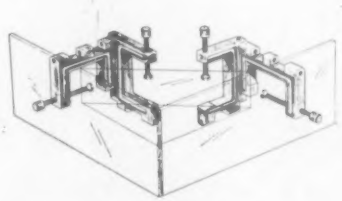
PORTABLE sales display kit contains 113 products including goggles, side shield glasses, welding lenses and plates, headbands and dust respirators. Manufacturer says contents of case has every item necessary to meet 90% of all weldors' eye protection needs. *Sellstrom Mfg. Co.*

Circle No. 5

Gas regulator

COMPRESSED gas regulator is small in size but is claimed to do job of any larger "two-stage" regulator. It can reduce pressure of oxygen, nitrogen, carbon dioxide, nitrous oxide or any high pressure gas to ounces. Unit has a range of 0 to 90 lb. *Beacon Devices Inc.*

Circle No. 6



Horizontal clamp

HORIZONTAL plate clamp was developed for handling large, unwieldy steel plates. Parts are drop forged and heat treated. Used in pairs, devices will quickly and safely grip, hold and convey swinging, jerking loads. *Merrill Bros.*

Circle No. 7

Electronic tracer

PHOTOCELL Tracer uses pencil or ink line drawings to control single or multi-torch oxygen flame-cutting machines. Built-in automatic kerf compensator makes it possible to accurately reproduce, from exact size drawings, one or thousands, of complicated metal parts. Tracer eliminates need for metal or plastic templates, photographic negatives, or complicated silhouettes.

Once kerf dial is set for plate thickness being cut it automatically compensates for kerf width so reproduced parts are same size as line drawing. Intricate metal shapes and small holes can be cut, says manufacturer. Machine is not sensitive to extraneous light and will not follow shadows. Tracing speed from 2 to 30 in. per minute is controlled by an eddy-current governor. At average speeds tracer can make 90 deg turns with 1/16-in. radius. Heart of tracer is photoelectric scanning head geared to a steering motor which is connected by a geared belt to drive head. *Linde Co.*

Circle No. 8

Plastic metal kit

FIVE-IN-ONE plastic metal kit contains pint of clear Flawmaster epoxy and five jars of powdered metals. Powders may be mixed with clear epoxy for special metallic bonding needs, or epoxy may be used to bond glass, china, plastic and wood. *Carl H. Biggs Co.*

Circle No. 9

Gas filler rod

AMPCO-BRAZ No. 4, a low-fuming gas filler rod for welding high strength bronzes and brasses, is produced from manganese bronze alloyed with nickel for high tensile strength. Filler rod can be used to repair and build-up bearing surfaces on steel, cast iron and malleable iron. It is readily applied in all positions using standard gas brazing and braze-welding techniques and fluxes. *Ampco Metal Inc.*

Circle No. 10

Protective clothing

NEW Fyre-Free clothing is made of 100% cotton cloth which is given a permanent-type flameproofing. Material has good tensile strength in both warp and fill, is mildew free and does not deteriorate in damp climates or operations. Clothing is available as sleeves, cape sleeves with or without bibs, aprons, coats, overalls and pants. *American Optical Co.*

Circle No. 11

Gas-drive welders

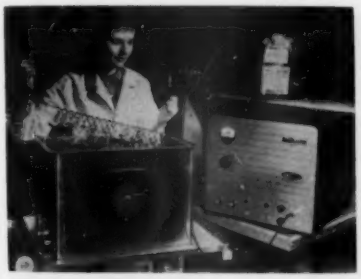
ALL welding operations in pipeline welding, construction, maintenance and repair work can be handled with new 200 to 400-amp series of d-c gasoline-engine-driven welding machines, says manufacturer. Welders have a specially designed welding generator coupled to a liquid-cooled engine. Model A2000W-G is a 200-amp unit with 40 to 250-amp work range, Model A3000W-GS is a 300-amp unit with 60 to 375-amp work range, and Model A4000W-GS is a 400-amp unit with an 80 to 500-amp work range. Maximum open-circuit voltage on all machines is 80 volts, the generators have a 60% duty cycle. *A. O. Smith Corp.*

Circle No. 12

C-clamp

COMPANY has new C-clamp with connection for welding cable. Clamp is made of copper alloy, weighs more than 3 lb, has a 4-in. jaw opening and a large serrated contact area. Model G has a deep cable socket for solder or mechanical connection. *Lenco.*

Circle No. 13



Ultrasonic cleaner

SERIES 5000 SonBlaster is said to be the first industrial size high power ultrasonic cleaning system to be mass-produced in this country. It consists of a 40-kc, 500-watt output Model G-5001 generator and a 10-gallon capacity transducerized cleaning tank Model NT-5001. Machine is capable of one minute or less of high-speed precision cleaning of large assemblies or parts as well as big loads of small components. Generator may be used to energize as many as 10 of this firm's submersible transducers, or to drive various combinations of small tanks of 600 and 15000 series. Generator operates on 110/220 volt-50/60 cps supply and consumes 8 amps. *Narda Ultrasonics Corp.*

Circle No. 14

Spooled aluminum

EXTRUDED and superclean 3/64 and 1/16-in. aluminum now come in 1-lb spools. Any type aluminum can be had on new spools, with analysis guaranteed to meet applicable government specifications. Spools are used for welding aluminum in ship super-structures, air conditioning and ventilating systems, and aircraft. *All-State Welding Alloys Co., Inc.*

Circle No. 15

Tube furnace

NEW line of molybdenum tube furnaces, capable of operating at temperatures to 3,000 F, come in three standard sizes of single end or double end furnaces. Control system safeguards against overloading elements and affords infinite temperature control. Reducing atmosphere protects elements. Explosion relief doors open and close vertically. *Hevi-Duty Electric Co.*

Circle No. 16

C-clamp swivels

NEW development saves on swivel pads for C-clamps. "Perma-Pad" swivels, said to be "loose-proof," are held in place by a retainer ring instead of by crimping. "Collar" area, where most wear occurs, is 60% thicker than standard swivels, firm says. Pad has free swing through a 60 deg arc. Only tool needed to install is a screwdriver. *Wilton Tool Mfg. Co., Inc.*

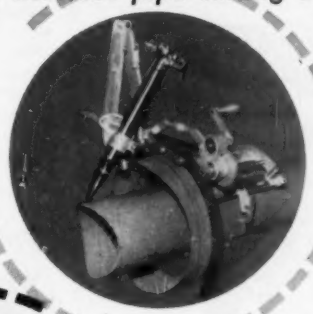
Circle No. 17

. . . for faster, more accurate pipe cutting and beveling

NEW IMPROVED

H & M Shape Cutter

PAT APPLIED FOR



H & M Out-of-Round

PAT NO 2843373

The new, light-weight H & M Shape Cutter makes the most difficult pipe cuts fast and simple. Saddles, tees and els are made to exact dimensions by use of the proper template and the H & M Shape Cutter. Advanced design of the new Shape Cutter features easy, fast mounting. The Shape Cutter is available in the same full range of sizes as the H & M Pipe Cutting and Beveling Machines.

The improved H & M Out-of-Round attachment features a free-wheeling roller assembly that turns a full 360 degrees. This roller rides the surface of the pipe and automatically makes corrections for any imperfections. Costly, inaccurate cuts and bevels are eliminated.

Write for fully illustrated catalog sheets on the new models of the H & M Shape Cutter and Out-of-Round Attachments.

H&M TM REG

PIPE BEVELING MACHINE COMPANY

311 E. Third St. — Diamond 3-0241

TULSA 20, OKLAHOMA

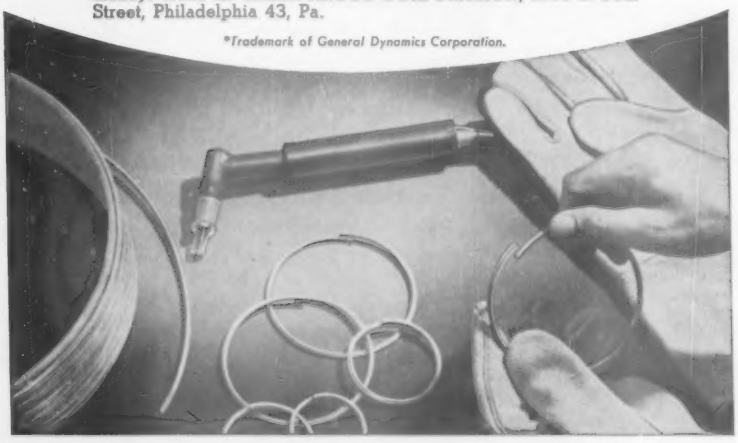
NEW WELDING PROCESS used to fabricate reactor test vessel

Job Report Courtesy of
Newport News Shipbuilding and Dry Dock Company

the ARCOS EB* WELD INSERT

To simplify and speed joining the halves of this pressure vessel shell, and insure corrosion resistant root passes, a preplaced Arcos Consumable Insert was used. With this method, *only outside welding* was required to produce sound welds with uniform contours on the inaccessible inside surface. The welds readily passed Radiograph inspection for freedom from porosity, slag and other inclusions. The EB Weld Insert can save *you* time and money. Write for details. ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.

*Trademark of General Dynamics Corporation.



Twin electrode holder

TWIN-HEAD electrode holder for double life and easy maintenance is 100% insulated and has cable lock that prevents rubber insulation on cable from sliding back and exposing strands. Insulated stainless spring prevents current from passing through it. Comes in 400 and 500-amp models. Renewable head encloses jaws protecting them from spatter. *Climax Corp.*

Circle No. 18

Tube control

COUNTING tube type precision control combinations for tri-phase d-c spot welders precisely regulates all welding timing adjustments, and is constructed for easy field maintenance, says manufacturer. Sequence indicator lights at top of control will identify portion of control if it stops functioning. *Taylor-Winfield Corp.*

Circle No. 19

Control relay

A NEW line of mechanically held control relays, rated at 10 amps, 600 volts, mount in the same panel space as standard electrically held relays. This eliminates need for mounting mechanically held relays separately. Relays are offered as completely factory-assembled units, or as electrically held relays and mechanically held attachments for customer assembly. A stock of electrically held relays, plus a few mechanically held attachments, reduces inventory requirements and provides maximum flexibility, says manufacturer. *Square D Co.*

Circle No. 20

Radiography

LOW, MEDIUM and high voltage radiography of pressure vessels, boilers, bridges, ships and pipe lines can be accomplished with new line of equipment. Line includes mobile, highly sensitive, oil and water cooled Isovolt units for examination of steel 2, 3, 4¼ and 5¼ in. thick; and portable, heavy-duty Eresco, MS or X-Tron series units for 360-deg circumferential or 40-deg single port X-ray examination of equipment in field. *Mitchell Radiation Products Corp.*

Circle No. 21

Brushless regulator

ABSENCE of brushes in company's Inductrol voltage regulator cuts down maintenance and insures reliability of voltage control, says manufacturer. Regulating winding is wound on a laminated steel stator, surrounding the exciting winding on a laminated steel rotor. As the rotor position is changed, the magnitude of the voltage induced in the series winding is controlled, adding to or subtracting from the supply voltage, to produce the required output voltage. *General Electric Co.*

Circle No. 22

Paste alloy

ST SERIES silver brazing paste alloy is used on automatic silver brazing production lines. Material eliminates separate application of braze alloy and flux. Paste can be used in automotive sub-assembly, heating and air-conditioning and electrical contacts where unit costs must be held down. Automatic dispensing system insures application of uniform amounts of paste on each joint. *Fusion Engineering.*

Circle No. 23

Gas torch

HARRIS No. 89-2 gas-air torch for large area soldering operations is designed to burn city or natural gas, propane or butane, in combination with compressed air. Torch has pilot light for quick lighting. Stainless steel burner head No. 81-12 is heat resistant—will not flake or scale. *Harris Calorific Co.*

Circle No. 24

Welding goggle

GOGGLE for welding and chipping has a frame made of a soft, flame-resistant vinyl plastic. The material is lightweight and conforms to contours of the operator's face. Eye-piece is molded to rigid plastic material which permits raising of both eye pieces as a unit without disturbing prescription glasses worn underneath. A cover lens protects 50mm green filter-lenses which are available in shades 3 to 6 for welding use. *Air Reduction Co., Inc.*

Circle No. 25

Closed-circuit TV

CLOSED-CIRCUIT TV for industry, business and education makes it possible to watch action and processes otherwise dangerous or inaccessible. Basic system consists of a vidicon camera, monitor and control unit. Camera has electronic light compensator eight times as great as normally covered by lens stops. Maximum control limit is 10,000 to 1 without change in iris setting. *Industrial Products Div., International Telephone & Telegraph Corp.*

Circle No. 26

When low alloy weld requirements are as *critical* as these

Job report courtesy of McKiernan-Terry Corp., Dover, N. J.

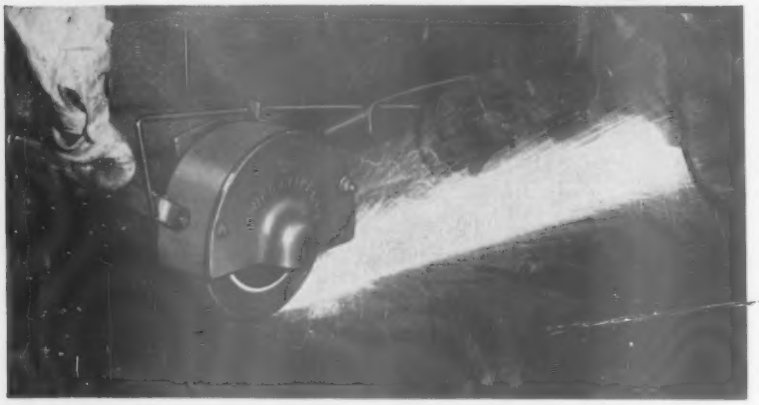
WELD WITH ARCOS

LOW HYDROGEN ELECTRODES

This crosshead weldment—part of a Navy steam catapult for launching jet fighters—must withstand the repeated powerful surges of steam under high pressure. Arcos Tensilend 80 electrodes were used to weld the SAE 4130 low alloy steel. After progressive magnaflux checking, and proper stress relieving, all welds were found to meet the high strength and toughness required for this kind of service. For the *right* weld metal—for the *right* welding techniques—for your tough welding problems—call on Arcos. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.

ATLANTIC WHEELS

spark new savings on snagging operations!



Take the toughest snagging operation you can find, add fast-cutting, cool-running Atlantic Grinding Wheels, and watch your grinding costs flatten out to a money-saving minimum. Made with a special resinoid bond to withstand high centrifugal forces, these work-proved wheels have a smooth, floating action that speeds up grinding . . . gives you cleaner surfaces with fewer passes.

Start saving now, by giving Atlantic Grinding Wheels a trial run in your plant. An Atlantic representative will gladly recommend the right wheel for your particular operation without obligation. Write for details and a copy of the **Atlantic Grinding Wheel Catalog.** Atlantic Abrasive Corporation, 540 Pearl Street, South Braintree 85, Massachusetts.

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STRAIGHT WHEELS • CYLINDER WHEELS • CUP WHEELS
CONES • PLUGS • MOUNTED WHEELS AND POINTS

☐ Please send Atlantic Abrasive Catalog.

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COMPANY_____

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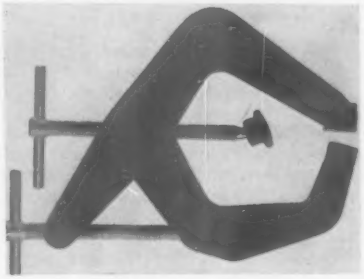


3-jaw clamp

A positioning screw has been added to company's Kant-Twist clamp to aid weldor or other workers who use work holders. Screw has a Swivel-Joint-Jaw to hold work in place. *Saxton Mfg. Co.*

Circle No. 27

Fixture system

A BASIC Unitube jig and fixture system consists of 323 elements and 500 ft of octagonal tubing that can be assembled into layouts for welding, pipe bending, etc. Standard joint elements look like sandwiches split on axis of tubing and held together by socket-head screws. Diagonal struts, provided for rigidity, are attached to joints by pins passing through holes in assemblies. Manufacturer says original investment is recoverable after 35 to 50 fixtures have been built with system. *Wharton Unitools.*

Circle No. 28

Brazing alloy

NICROBRAZ No. 170, nickel-chromium-boron brazing alloy, is said to produce high-strength joints for continuous service at temperatures from room up to 2,000 F, and can be used at 2,200 F. Alloy can braze tungsten and molybdenum bearing alloys, providing ductility to resulting joint, as well as small fillets and good wetting. Flow is good in shallow joints and excellent when used in pure dry hydrogen and vacuum atmosphere, says manufacturer. Liquidus is 2,020 F, solidus is 1,790 F. Best brazing range is 2,150 to 2,200 F in pure dry hydrogen. *Wall Colmonoy Corp.*

Circle No. 29

Isotope machine

TECH/OPS is a 58-lb portable isotope machine that permits one-man radiographic inspection of industrial equipment. Unit can be operated with either Iridium 192 or Thulium 170. When loaded with an Iridium 192 source of 10 curies, it radiates energy equivalent to that of a 600,000-volt X-ray machine; when 50 curies of Thulium 170 are used is radiates energy equal to that of a 125,000-volt X-ray machine. Using Iridium machine can radiograph steel piping and storage tanks, using Thulium, it can radiograph steel less than ½-in. thick and aluminum less than 1½-in. thick. *Picker X-Ray Corp.*

Circle No. 30

Respirator filter

RED DEVIL filter, for respiratory protection against dusts no more toxic than lead, pneumoconiosis-producing mists and chromic-acid mists, is composed of a red prefilter and filter body. Prefilter is made of interlocked viscose fibers thermally bonded to filter body. Filter body is composed of microfine viscose, vinyon and ultrafine asbestos fibers. Fits company's standard single and twin cartridge respirators. Breathing resistance is ½-in. of water at 85 liters per minute of air flow. *American Optical Co.*

Circle No. 31

Gouging electrode

CHAMFERARC electrode is for chamfering, gouging, grooving and routing of ferrous and nonferrous metals. Can be used with a-c/d-c power source, requiring no special equipment. Mild steel core burns back up inside flux coating, igniting flux element and causing blowing action. Ignited flux elements escape arc crater taking molten and disintegrated metal from work piece. Electrodes come in ⅛, 5/32 and 3/16 in. sizes to be used with 200 to 550 amp power. *Kenco.*

Circle No. 32

Filler metal

CURTISOL filler metal is for soldering titanium and titanium base alloys at low temperatures. Flow temperature is between 1,300 and 1,400 F. Butt joints with tensile strengths of 40,000 psi can be made. Solder can be used for short term vacuum furnace or inert atmosphere brazing without flux. Fluxing agent, Certiflux, is specifically compounded for low temperature silver solders. It melts at 1,000 F and can be heated to 1,500 F without decomposing, sputtering or balling up. *Curtiss-Wright Corp.*

Circle No. 33

Indexing turntables

DESIGNED for use in the production of polyethelyn bottles, machine 88-8-IX carries six air-operated mold holders on a turret. Shape and type of bottle produced depends on die. Machine is usually used in conjunction with an extruder for tubing, and is made to index by means of a geneva gear on barrel cam. Includes a dual rotary connection that provides air for mold operation as well as water for cooling molds. Requires a ¾-hp engine to produce 900 bottles an hour. *Eisler Engineering Co., Inc.*

Circle No. 34

Station regulators

AIRCO 9900 is series of single-stage inverse-type station regulators for low-pressure service designed to handle inlet pressure up to 300 psi. Hand tightening of brass retaining ring seals against leakage by means of rubber ring which is part of diaphragm. Molded rubber diaphragm has nylon fabric insert. *Air Reduction Co., Inc.*

Circle No. 35

ELECTRIC-ARC INC.

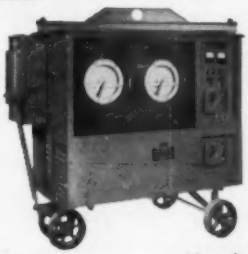
One of a Series on Applications of Electric Arc's Smith-Dolan Units — Today's Most Versatile Heat-Treating Tools.

STOP WELD FAILURE *with the* SMITH-DOLAN SYSTEM *of Low-Frequency Induction Heating*

Here is the versatile heat-treating tool you need for producing sound welds easily and economically in carbo-alloy and other types of steel pipe . . . here is precision control of heating cycle when pre-heating and stress relieving — uniform, through-and-through heating of solid sections up to two feet thick and more — pushbutton operation — complete portability for on-the-job heat treating anywhere.

Many Money-Saving Applications — The Smith-Dolan System simplifies and upgrades work quality in numerous applications ranging from welding to forming and annealing. Units are available for 60 cycle heating in capacities ranging from 10 to 150 KVA . . . for 400 cycle heating . . . resistance heating. Pre-engineered with complete instrumentation, accessories.

"On Trial" Installations on Rental Basis — Prove the many Smith-Dolan advantages in your own plant without capital investment. Write, wire or phone.



Electronic recording gives permanent charts of heat run on this standard Smith-Dolan model. Coils permit work at 50 feet or more from unit. Eye hooks provide for easy handling by crane. Products ranging from a fraction of an inch to 10 feet in diameter can be heat treated on the job.

New Brochure — Send today for your copy of "Smith-Dolan System of Low-Frequency Induction Heating."

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Representatives in Principal Cities

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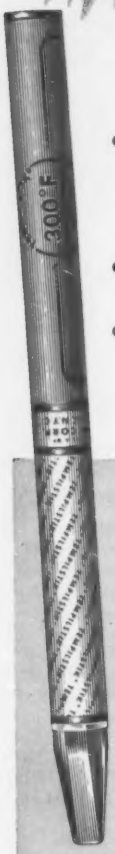
THE CRAYONS THAT TELL TEMPERATURES



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"I" rule

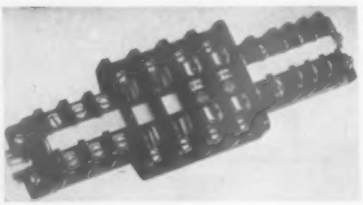
DETERMINATION of moment of inertia of irregular sections is simplified with I rule. It converts an irregular section into two simple rectangles. Moment of inertia is found by $I = Wh^3/3$ formula. Inertia of both rectangles are added together to obtain moment of inertia of original irregular section. Accuracy is said to be within ½%. *Lincoln Electric Co.*

Circle No. 36

Portable heaters

LINE consists of nine models of three completely different types of heaters to provide an LP-gas heater for every portable use, says manufacturer. Line includes salamanders, infra-red heaters and improved 1700B and 1710B blower heaters. All units operate on LP-gas and are said to be ideal for all construction work and industrial plants, etc. *Insto-Gas Corp.*

Circle No. 37



Terminal block

TYPE H fusible terminal block for applications where fuse protection is needed for solenoids and other single or three-phase loads is rated at 30 amp, 600 volts. Block will accept any ferrule type fuse 13/32-in. in diameter by 1½ in. long. Made up of individual blocks mounted on a channel, it can be combined with four types of terminal blocks for increased flexibility. Available in assembled units or kit form. *Square D Co.*

Circle No. 38

Vaporizer-regulator

LP-GAS vaporizer-regulator Model 60 weighs 1½ lb, is 4 in. in diameter, and with a maximum thickness of 3 in. can handle up to 60 hp engines. Suitable for LP-Gas conversion of fork-lifts, farm tractors and small industrial machines. Regulator has built-in vacuum lockoff device and freeze plug protection. It uses no gaskets and screws in water chambers. Parts can be replaced in field without special tools. *Beam Products.*

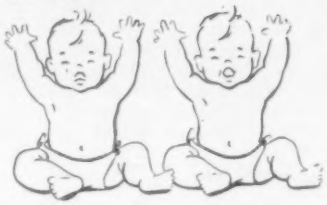
Circle No. 39

Low-temp refrigeration

LOW-TEMPERATURE refrigerating system, designed for temperatures ranging from —20 F to —260 F, has several industrial applications. For example, unit can be used for low temperature grinding of certain plastics; recovery of liquid carbon dioxide from flue gas mixtures; and helium purification by cooling and absorption. *Philips Electronics Inc.*

Circle No. 40

YOU GOTTA KEEP 'EM DRY!



Moisture "messes up" electrodes, too, cuts welding profits.

End costly reworks by drying rods in

DryRod® OVEN

Mineral coated electrodes are *thirsty*. The instant you unpack them they start soaking up moisture . . within 2 hours often as much as 13 times US allowable specifications. Moist rods cause porosity, under-bead cracking, rough welds, etc. Rod scrap runs high Production slows down. Reworks eat up profits.

Storing rods in DRY-ROD OVEN prevents such losses, insures faster, finer workmanship at less cost.

Write for new literature on latest rod-drying methods, "Dry Rod as Standard Welding Equipment."

PHOENIX PRODUCTS COMPANY
4727 N. 27th St. • Milwaukee 9, Wis.

Clamp

THIRD HAND holding device can clamp miter or box joints and other odd shaped pieces. Clamp is designed to fill gap between one unit assembly job and high volume production which warrants custom made locating fixture. Clamps are shaped so they may be joined back to back, top to bottom, in parallel, vertical or horizontal positions, providing 40 combinations. Clamps are copper clad to resist weld spatter. Jaw openings are 2 to 4 in. Each set of clamps comes with locking wrench. *Merrill Bros.*

Circle No. 41

Silicon rectifier

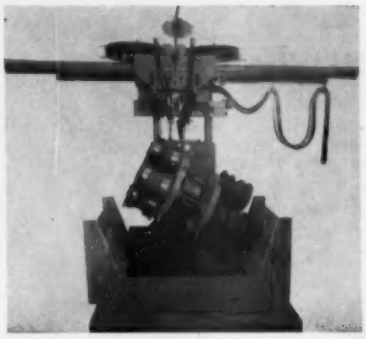
RECTIFIER power units, a-c to d-c, are available as silicon rectifiers. Power units have 92 to 97.5% power factor, 10% voltage regulation from no load to full load, 4% ripple in direct current, low no-load losses and high overload capacity. Three-phase units range from ¾ to 500 kw for single units. Single-phase unit watt outputs range from 250 to 3,000. *Syntron Co.*

Circle No. 42

Test control

FIVE-IN-ONE Control, for test set-ups at factory production positions, provides from any single a-c outlet, five overload-protected and safety-grounded a-c outlets. Outlet sockets have 15 amp on-off switch, accepts both three-prong grounding plugs and conventional two-blade plugs. An instant reset circuit-breaker trips at 15 amp. Comes with 6-ft power cord having three-prong self-grounding plug and adapter for use in two-blade sockets. *Arthur S. LaPine & Co.*

Circle No. 43



Welding fixture

MODEL DEMS, double ended multiple spindle, welding fixture has eight spindles to help increase weld cooling cycle when hard-facing rollers. Dual heads have independent controls for current, positioning and move-over. Single console power supply operates on standard 3 phase, 60 cycle a-c power. Cantilever arm offers full vertical travel to maintain welding at same height at all times, and 360-deg rotation in order to build-up flanges without remounting roller. *L & B Welding Equipment Inc.*

Circle No. 44

Hydraulic boosters

AIR-HYDRAULIC boosters are designed to mount vertically, preventing weight of internal parts from causing distortion in hydraulic seal. Air filter is mesh of solid bronze particles. Chambers are made of honed seamless steel tubing instead of castings, and hardened steel tie-rods connect air chamber to hydraulic chamber. *Wilton Tool Mfg. Co., Inc.*

Circle No. 45

Surface grinder

TABLE speed which reduces grinding time as much as 50% over similar machines is claimed for 18-in. Type S-3 Hydraulic Surface Grinder. Maximum table traverse speed of 125 ft per minute is said to be fastest available on any grinder of this capacity. Machine can grind workpiece 15-in. above work table with standard 8-in. wheel. It has a two-speed vertical fine feed handwheel graduated in increments of 0.0001-in. Sliding table and saddle ways are automatically lubricated. *Norton Co.*

Circle No. 46

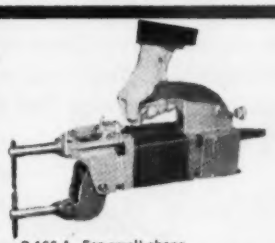
First aid kits

EMERGENCY treatment is facilitated by using G-S Unit Type Kit containing wrapped items, boldly marked and arranged for immediate recognition and access. Kits are available with 10, 16, 24 and 36 units of standard assorted first aid items, or with custom items to meet specific requirements. *General Scientific Equipment Co.*

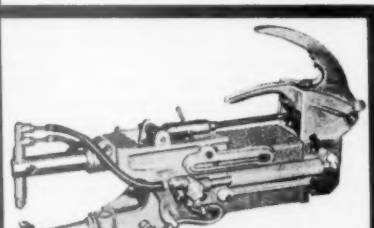
Circle No. 47

ARO

A BETTER SPOT WELDER for every job



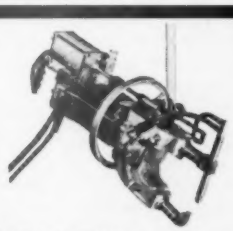
P-166-A—For small shops. Semi-automatic timing. Low cost.



P-298-A—Hand operated. Ideal for average shop.

Most models available with automatic timer

DP-35—For jobs that are accessible from one side only.



P-410—Air operated. Recommended for heavy production.

write for illustrated literature

ARO SPOT WELDERS

DIVISION OF

GUTHERY MACHINE TOOL CORPORATION

38-31 CRESCENT STREET LONG ISLAND CITY 1, NEW YORK

Dealer Inquiries Invited

JOB-PROVED
Welding Accessories
by LINDE
Oxweld GOGGLES

CAN BE WORN
OVER EYEGLASSES

OXWELD No. 24 Coverall Goggles have enlarged eyecups which fit over eyeglasses. They give *comfortable* eye protection with excellent visibility—minimizing eyestrain and fatigue during welding and cutting. Frames are lightweight, heat-resistant nylon plastic with vents around lens rings for full, non-fogging ventilation. The rigid metal bar permits goggles to be raised with one hand. The standard Type "AA" green filter lenses are available in Light, Medium, or Dark shades.

Oxweld GLOVES
LONG GAUNTLET PROTECTION

Made of tough, flame-resistant suede leather, these OXWELD Long Gauntlets are 13⅝" long to provide full protection for wrists and forearms as well as hands. They are unusually soft and comfortable.

See your LINDE supplier for prompt service and a complete line of job-proved, quality equipment and accessories for every oxy-acetylene welding and cutting need. Or write for his name and address to LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

Linde TRADE-MARK
UNION CARBIDE

"Linde," "Oxweld" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Panel receptacle

HIGH-IMPACT plastic panel receptacle for power connections without tools is self-contained and self-insulated. It can be mounted on electrical distribution cubicles, switchgear, junction boxes, bus duct, wire-way or any electrical panel to produce a "dead-front" connection. Plastic insulation assures shockproof mounting, prevents short circuiting of distribution equipment and safeguards personnel, says manufacturer. Receptacles and plugs accommodate cable sizes from 16 to 4/0. *Cam-Lok Div.*

Circle No. 48

Gageless regulator

GAGELESS regulator Model 77 is designed to reduce maintenance costs brought about by broken gages, inlet stems, adjusting screws, ruptured diaphragms and leaking seats. Content indicator records cylinder conditions when flush with outer container, replacing high pressure gages. Pressure indications are embossed on bonnet, replacing low pressure gage. Short inlet connection reduces breakage. Both intermediate and working pressure stages are protected by safety valves. Regulators are for all commercial gases delivering 0 to 100 lb. *Harris Calorific Co.*

Circle No. 49

Toggle clamp

FLEX-o-matics, a new series of flexible toggle clamps, are die-cut and formed from high carbon steel. Four of the six models have tempered flat spring-action jaws which automatically compensate for material thickness from pre-set dimension to recommended additional ⅜-in. jaw gap. The other two models combine automatic flat spring-action with screw-type spindle assemblies. Weights and holding pressures of the models are: Models 420, 421—35 lb ⅛-in. deflection; Models 421-1, 421-2—150 lb; Models 431-1, 431-2—350 lb. *Detroit Stamping Co.*

Circle No. 115

Finishing equipment

VIBRATION-free operation is claimed for new line of precision barrel finishing equipment in Model 30 series. Includes molded fiberglass safety gate and full opening doors "super-sealed" by special cam locks. Safety controls prevent machine from operating with gate open, except for "jogging." Machines ranging from 5 to 30 cu ft capacity, having one to six compartments designed for both wet and dry processes are available. Standard cylinders are lined with ¼-in. calendered Neoprene. *Techline Div. of Wheelabrator Corp.*

Circle No. 116

NEWS . . . . . *from page 8*

affecting the choice of gas shielded metal-arc processes," by R. C. Becker, International Harvester Co.; "Arc-welding of HY-80 and T-steels," by R. David Thomas, Jr., Arcos Co.; "Recent developments in welding abroad," by Clarence Jackson, Linde Co.; "Resistance welding application at Western Electric Hawthorne works," by John D. Eyestone; and "New developments in resistance welding," by Arthur Schueler, Precision Welder and Flexopress Corp.

The second day's papers are: "Economics of welding fabrication," by John Mikulak, Worthington Corp.; "Welding of rails for railroads," by by R. H. Beeder, Topeka and Santa Fe Railway System; "Use of welding in highway construction," by Clarence R. Rea, Texas Highway Dept.; "Welding in missile applications," by William A. Wilson, Army Ballistic Agency; "The case for stress relief annealing," by Corbin Chapman, Combustion Engineering and "The case against indiscriminate use of stress relief annealing," by Louis J. Larson, Allis-Chalmers Mfg. Co.

Hoglund attends New England conference

Gustav O. Hoglund, president of the American Welding Society, attended the recent annual New England Conference on Welding at Providence, R. I.

The conference, sponsored by the AWS District No. 1, consisted of a three-part program. Technical sessions on structural welding, welding of tanks, pressure vessels and piping, cost cutting through welding, inspection, welding for nuclear service and brazing for high temperature service were conducted.

Demonstrations on welding aluminum, stainless steel, cast iron and piping were given. The closing talk was on training and qualifications of weldors.

Construction begins on Solar brazing furnace

Construction has started on a huge 1,000-kw furnace for heat treating and brazing missile components at Solar Aircraft Co.'s San Diego bayfront property.

The furnace will be 31 ft deep and 15 ft in diameter. It will be almost entirely below ground, but the building housing the furnace will be 50 ft high. A vertical above-ground heat treating and brazing unit will be in the enclosure.

Missile fuel tanks and other components up to 9 ft in diameter and 30 ft long will be handled by the furnace. Temperatures up to 1,950 F will be available.

Solar will start construction on a 60,000-sq-ft research and engineering building on the same site early this year.

All-State incorporates Canadian subsidiary

All-State Welding Alloys Co., Inc., White Plains, N. Y., has incorporated a wholly-owned Canadian subsidiary known as All-State Welding Alloys Co. of Canada, Ltd., located at 141 Kipling Ave., S., Toronto.

Complete stock of All-State products will be available from the Canadian company. According to the charter of the subsidiary, manufacturing can take place in the future.

Lukens offers matched electrodes and wire

Welding electrodes and wire recently introduced by Lukens Steel Co., New York City, are available for the first time to steel-plate fabricators in the Boston, New York and Richmond areas.

Lukens is said to be the nation's first steel producer to offer a complete range of welding electrodes and wires specifically matched to its entire line of alloy and carbon-steel plates.

CAYUGA Machine & Fabricating Co., Inc., has expanded its Depew, N. Y., plant. New facilities are said to triple company's production capacity.

FOR A COMPLETE LINE OF INDUSTRIAL GASES, WELDING EQUIPMENT AND SUPPLIES

see your **LINDE** distributor

He is a welding specialist and has the technical knowledge and experience to help you with your welding and cutting problems.

Every authorized LINDE Distributor is an independent local businessman and carries a complete line of quality equipment and supplies—to give you prompt service.

A telephone call to your nearby LINDE Distributor will bring you the benefits of more than 50 years of LINDE COMPANY's pioneering and leadership in welding and cutting. If you don't know your local LINDE Distributor, look in your classified telephone directory. Or write for further information to LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Linde UNION CARBIDE

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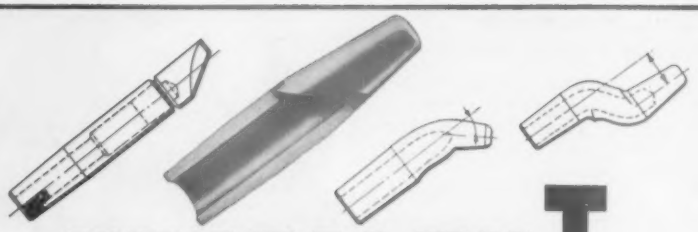

TUFFALOY

Resistance Welding Alloys

• **SPOTWELDING TIPS, a complete line . . .** R.W.M.A. Standard Tips, 'Tuffcap' Standard Tips, Cold-Formed Tips, Copper-Tungsten Faced Tips and many "Specials", all *carried in stock* in a wide selection of active types and sizes.

• **BAR STOCK,** round, hexagon, square and rectangular.

• **FORGINGS,** a large stock of bars and wheels available for finishing. Special forgings to order, rough, or finish-machined.

• **WELDING TIP HOLDERS and ADAPTERS**

You too may depend on *Tuffaloy,* with its record of over twenty years of prompt service and consistently high quality.

See your nearest AIRCO or TUFFALOY representative.

Ask for Catalog and Price List.

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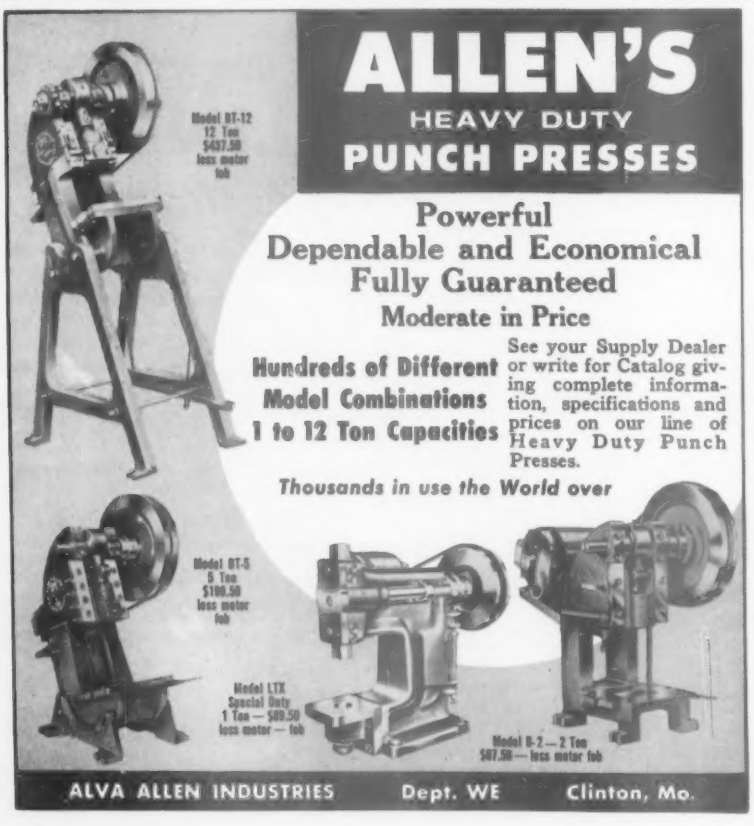

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HEAVY DUTY PUNCH PRESSES

Powerful
Dependable and Economical
Fully Guaranteed
Moderate in Price

Hundreds of Different Model Combinations 1 to 12 Ton Capacities

See your Supply Dealer or write for Catalog giving complete information, specifications and prices on our line of Heavy Duty Punch Presses.

Thousands in use the World over

ALVA ALLEN INDUSTRIES Dept. WE Clinton, Mo.

KSM opens San Francisco warehouse, sales office

KSM Products Inc., Merchantville, N. J., has established a new warehouse and sales office in San Francisco. John T. Rayner is regional manager for the area. He will be assisted by F. G. Kern.

The office will carry a complete line of stud welding equipment and accessories and will supervise and service stud welding accounts for the central and northern California areas, as well as Washington and Oregon.

Another new office has been established in Los Angeles, with Leonard Hultquist sales engineer. This office will receive materials from the San Francisco warehouse.

Johns-Manville opens Chicago plant

The seventh plant opened in a year by Johns-Manville Corp., New York City, is located in Chicago. The 105,000-sq-ft plant will manufacture pressure-sensitive tapes, adhesives and related rubber products.

Germany oxygen-process steel plant being built

A $25,000,000 oxygen-process steel plant is being built by Phoenix-Rheinrohr A. G., in Dusseldorf, West Germany. The plant will have three converters, each with a capacity of 70 tons. Total monthly output will be 115,000 tons.

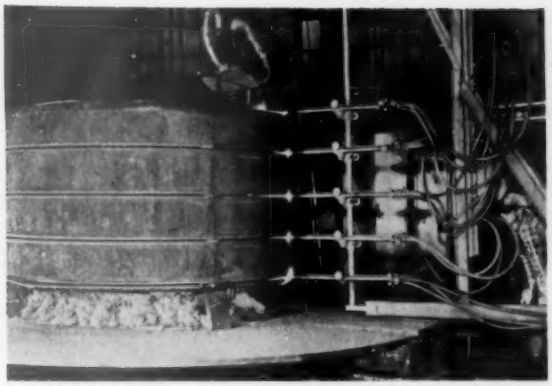
WE has distributor for new neighbor

City Welding Sales & Service, Morton Grove, Ill., is a new welding supply house that has opened less than two miles from the publishing offices of WELDING ENGINEER. The new distributorship is managed by John Coffey.

New cryogenic insulations devised by Linde Co.

Using new insulations, Linde Co., New York City, says it is able to build liquid oxygen storage tanks for missile stands that will hold the volatile liquid for years with little loss.

Liquid hydrogen and helium storage containers that need no liquid nitrogen coolant can also be built. Linde is now using the best of the new insulators, said to be 26 times more efficient than standard vacuum insulations, to construct a large unvented liquid helium vessel. Pressure rise for the vessel will be below 180 psi for 15 days.



MIDVALE Heppenstall Co., Philadelphia, has cut production costs of standard flame cutting operations by mounting five Linde Co. cutting torches on a vertical jig and rotating forgings horizontally past torches. Setup can cut low carbon to high alloy steel from 36 to 200 in. OD. Operation above produces four rings of equal thickness. After rings are cut, vertical and angled torches make finishing cuts.

MORRIS D. Thomas, seated, head of welding engineering at General Motors Institute, Flint, Mich., demonstrates arc-welding console to Educational Activities Committee of AWS. Group held recent meeting at institute. Members are, left to right, C. E. Jackson, R. B. McCauley, J. N. Alcock and Fred L. Plummer, AWS national secretary. Committee was named to develop guidance manual for setting up a welding department.

Dry-hydrogen furnace used for vertical brazing

A dry hydrogen furnace permitting vertical brazing of assemblies up to 10 ft long and 6 ft in diameter has been installed at the Detroit plant of the Stainless Processing Div. of Wall Colmonoy Corp.

The instrument-controlled unit, designed and built by the division, is available for controlled atmosphere brazing, heat treating and annealing. It can be used with pure dry hydrogen, argon, carbon dioxide, nitrogen or exothermic atmospheres.

The furnace was designed to produce large brazed assemblies able to meet the stringent distortion-free specifications of atomic energy and missile programs.

Turco Products expands facilities

Turco Products Inc. is expanding its Wilmington, Calif., facilities. The new buildings, slated for occupancy in May, will house administrative, research and engineering facilities, and will cover 66,000 sq ft. Turco is a producer of industrial chemical processing components.

Airline FEATURES A BROAD VARIETY OF BACK-UP MANDRELS FOR AIRLINE LONGITUDINAL WELDING POSITIONERS

MODEL 1064B pre-heated back-up mandrel for use with Airline Model LW 10,000 Series Longitudinal Welding Positioner. Equipped with four "quick-clamp" back-up bar receiving grooves 90° apart. One heating oil inlet and outlet. Each back-up insert receiving groove is equipped with gas back-up plenum.

Mandrels are available for welding foils of .003" up to sheet stock of .250". Mandrels are furnished for welding ferrous, non-ferrous, austenitic and ferritic metals. Various models are designed to facilitate positioning of tubular, flat or rectangular shapes and are rotatable and interchangeable. Copper, steel or stainless steel back-up bars are furnished with weld "drop-thru" grooves to control weld root bead, size and contour. Many models are furnished for inert gas backing, featuring a plenum gas reservoir. Inserts are provided with orifices for uniform gas distribution along the weld. Many of these models are designed for normal "chill-shunt" weld tooling principles while others employ thermostatically controlled heating or water cooling.

Stainless steel and steel back-up inserts are for use in welding non-ferrous materials such as aluminum and magnesium alloys. Copper back-up inserts are used for welding steel, stainless steel, titanium, tantalum, molybdenum, zirconium, beryllium-copper, etc.

Write for complete information on Airline Longitudinal Welding Positioners and accessory equipment.

MODEL 1063B water cooled welding back-up mandrel commonly used for high production submerged arc and MIG welding applications. Equipped with two removable copper back up inserts

MODEL 1460A heavy duty welding back up mandrel designed for welding large cones, cylindrical shaped objects and flat sheet

MODEL 1060A heavy duty welding back up mandrel equipped with one copper back up insert. Designed for welding large diameter and long (up to 12' 0") heavy walled cylindrical objects

MODEL 1662-4 thermostatically controlled pre-heated mandrel for use in welding medium alloy steels. Equipped with one removable copper insert and gas back up plenum

MODEL 1121A small diameter welding back up mandrel equipped with one removable copper back up insert and gas back up plenum. For welding small diameter tubing

All illustrated mandrels are interchangeable in all Airline Longitudinal Welding Positioners

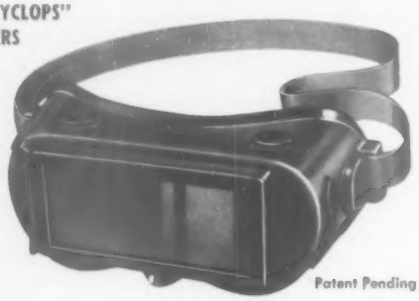
Airline WELDING AND ENGINEERING
760 NORTH PRAIRIE AVENUE, HAWTHORNE, CALIFORNIA

Patent Pending

STYLE 5050—
WELSH "SOFT-I"
COVER GOGGLES
FOR WELDERS

SOFT, LIGHT, PLIABLE WELSH FRAMES
PROVIDE NEW COMFORT IN EYE PROTECTION

STYLE 5070—WELSH "CYCLOPS"
EYE SHIELDS FOR WELDERS
with simplified
lens holder.

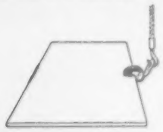


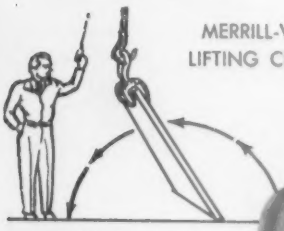
Patent Pending

WELSH MANUFACTURING CO.
4 MAGNOLIA ST., PROVIDENCE, R. I.

MERRILL MB BROTHERS

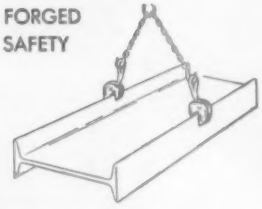
MATERIAL HANDLING DEVICES





MERRILL-Volz
LIFTING CLAMP

DROP FORGED
FOR SAFETY



- Safety Factor—5 to 1
- Factory tested at triple rated capacity.
- Will lift from horizontal or vertical position.
- Cam and Pads of case hardened tool steel.

- All operating parts replaceable when worn.
- Swinging or jerking loads will not affect grip.
- Useful for positioning in welding operations.

The HEAVIER the LOAD • • • • • the TIGHTER the GRIP! 3-T-17

MERRILL BROTHERS

56-81 ARNOLD AVE., MASPETH, N.Y.

S. CLARK, East Bradenton, Fla., can accurately measure length of time he uses Tig welder on a job. Clark has attached a springloaded arm to welder, from which gun is suspended. When gun is removed for use, arm actuates mercury switch hooked to a self-starting electric clock. Clock runs while gun is in use, stops when gun is returned to hook. Clark does ornamental iron work, aluminum welding and specialty work on other materials.

License agreement enables Haynes to produce alloys

Haynes Stellite Co., Div. of Union Carbide Corp., Kokomo, Ind., has procured a license that will enable it to produce alloys 713-C and 500.

Alloy 713-C will be marketed as Haynes Alloy No. 713-C. It was developed by International Nickel Co. and is a nickel-base, investment-casting alloy. Alloy 500, available in both wrought and cast forms, is a high temperature material developed by Utica Metals Div. of Kelsey-Hayes Co. It will be sold as Hastelloy Alloy 500.

Buckeye, CB&I form joint company

Buckeye Tank Terminals Inc., is the name of the company recently formed and jointly owned by Chicago Bridge & Iron Co. and Buckeye Line Co.

The new company, with headquarters in New York City, is headed by Charles Ashmun. The company will construct, own and operate terminal tankage on the Buckeye Pipe Line system, and at other locations.

Ansco building midwest sales office

Ansco Div. of General Aniline & Film Corp., is building a $1,000,000 midwest sales division in Lincolnwood, Ill., a Chicago suburb. The 40,000-sq-ft office and warehouse will replace current quarters at 247 E. Ontario.

Engineers tour Hobart school

The Mid-Western chapter of the Ohio Society of Professional Engineers held its recent meeting at the Hobart Bros. Technical School, Troy, O.

Howard B. Cary, director of the school, addressed the 42 members. He talked about welding operator training and qualification procedures. A tour of the school's facilities followed the talk.

American Brake Shoe builds research center

Construction has begun on the Denison Hydrodynamics Research Center of American Brake Shoe Co., Columbus, O. The building's services will be available to all divisions of the firm, including its American Manganese Steel Div., Chicago Heights, Ill., as well as the government and outside companies.

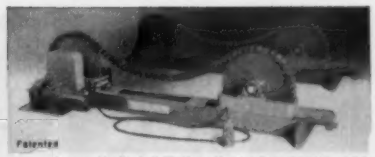
Expert develops combination machine

A new 10-station in-line transfer-automated welding machine combining assembly welding and heat treating operations while producing disc and hub assemblies has been developed by Expert Welding Machine Div., Expert Die & Tool Co., Detroit.

The machine press-assembles two carbon-steel transmission parts, preheats and welds assembled parts, and heat treats the welded assembly in one continuous operation. Transmission parts are produced on this machine at a rate of 120 assemblies per hour. Parts are transferred from station to station by a 20-ft longitudinally reciprocating bar.

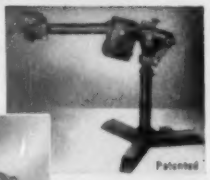
DAYTON section of the American Welding Society sponsored a 13-session lecture course on resistance welding recently. Projection welding samples are being examined by some of 145 participants in course.

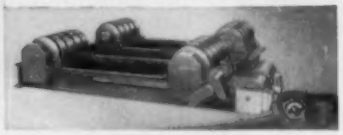
ARONSON
Offers You Over 200 PROVEN Standard Stock Models of Quality POSITIONERS "POSITIONEERED" to your exact Requirements



Aronson TracTred (T. M. Reg.) Turning Rolls for thin-walled heavy cylindrical work to 27 tons capacity. Zero to 100 IPM turning speed and Built-in Grounding.

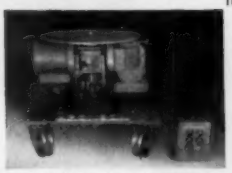
Aronson Universal Balance Positioners (T. M. Reg.) position your weldments effectively, instantly for downhand welding. Capacities to 2000 lbs.



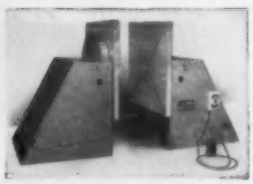


Heavy Duty Precision Built Rubber and Steel Tired Turning and Pipe Rolls, 100% overload protected. Capacities to 600 Tons.

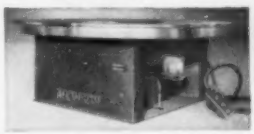
Fully Automatic Gear Driven Positioners, featuring Geared Elevation, 135° Tilting and Variable or Constant Speed Rotation. Capacities to 350,000 lbs.



Model D Gear Driven Positioners. Compact, Precise, Rugged. Capacities to 1000 lbs.



Rugged Head and Tail Stock for positioning bulky weldments between centers. Table Backup for Zero Deflection, Magnetic Braking. Capacities to 160,000 lbs. Geared Elevation Optional.

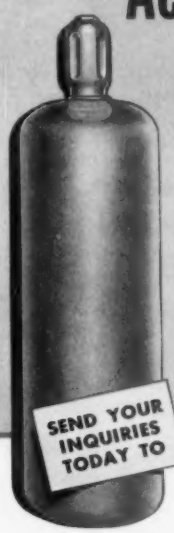


Heavy Duty Floor Turntables with precision speed control and Magnetic Braking, used for welding, burning, X-raying, etc. Capacities to 120,000 lbs., various heights and speeds.

Bench Turntable Automatic Positioners with Mercury Grounding. Capacities to 500 lbs.

Quality POSITIONERS by Aronson MACHINE COMPANY
ARCADE, NEW YORK

LOOKING FOR THE BEST? Buy INDEPENDENT Acetylene Cylinders



Unconditional Guarantee
Proven Filler - No "Spitting"
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Seamless Cylinders for Durability
Alloy shells for Lighter Weight
Cylinder Shells - Meet all ICC Requirements
All Cylinders "WHEELABRATOR" cleaned
Standard Sizes in Stock - Special Sizes on Request

Independent also manufactures Low Pressure Acetylene Generating Plant Equipment.

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INDEPENDENT ENGINEERING COMPANY, Inc.
Manufacturers of
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CYLINDERS AND GAS PRODUCING EQUIPMENT
ACETYLENE - OXYGEN - NITROGEN - ARGON
O'FALLON 5, ILLINOIS

with ALL-STATE special alloy rod
broken · cracked

CAST IRON

can be chamfered · cut · welded in place

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Instruction Manual covers whole line. Ask for FREE Copy

Weldors demand All-State's family of electrodes for cast iron repairs • less dismantling • low cost • low heat.

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Distributor stocked everywhere! Convenient to buy! Economical to use!
ALL-STATE WELDING ALLOYS CO., INC., White Plains, N.Y.

NATIONAL CARBIDE
IN THE RED DRUM

HIGHEST QUALITY

DUST FREE

DEPENDABLE SUPPLY

Write for the name and address of the NATIONAL CARBIDE supplier nearest you.

National Carbide Company
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED
GENERAL OFFICES: 150 EAST 42ND STREET, NEW YORK 17, N. Y.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT

SERVICE life of coffee pot bodies is said to be improved when they are formed on Airline Welding & Engineering Model R-42236 weld roll planisher. After body is formed it is Tig fusion-welded. Welded joint is roll planished to improve its surface. Fifteen seconds is required to load, planish and unload.

Airco, Mastic tile form chemical firm

Air Reduction Co., Inc., New York City, and Mastic Tile Corp. of America, Vails Gate, N. Y., have formed the Cumberland Chemical Corp. The corporation will produce materials for use by Mastic Tile in manufacturing floor covering and other building construction products.

The new firm will produce vinyl chloride monomer and vinyl chloride polymer at a plant to be constructed in Calvert City, Ky. Acetylene, a major raw material in both products, will be supplied by Airco.

Eutectic opens Chicago warehouse-service center

Eutectic Welding Alloys—Central Div. Inc., Chicago, formerly E. W. Sales and Welding Service Inc., has been added to Eutectic's nationwide string of warehouse-service centers. Les Soliday is manager of the facility. The center carries Eutectic low temperature welding alloys, and has a staff of sales consultants.

Salesmen training session conducted by Linde Co.

In conjunction with its distributor development program in the western states, Linde Co., New York City, recently held a two-day training session for 33 sales representatives of distributors in the San Francisco area.

The session included discussions on welding apparatus sales features, industrial gas production and distribution, fundamentals of basic welding processes and tips on successful selling techniques.

In the past several months Linde sessions have been held in seven west coast cities and have been attended by 350 persons.

New offices for WC&D Inc.

Whittaker, Clark & Daniels Inc., manufacturers of colors and pigments, have moved from 260 W. Broadway to 100 Church St., New York 7, N. Y.

AUTROMETER, automatic X-ray fluorescent spectrograph, is used at Haynes Stellite Co., Kokomo, Ind. Unit, developed by North American Phillips Co., quickly analyzes metal by comparing a sample against a known standard through use of alternating X-ray beams.

Pipeline news

Thirty-four miles of 20-in. pipeline and a regulating station can be constructed and operated by Manufacturers Light and Heat Co., Pittsburgh, says the FPC. The cost of facilities to be built in Greene, Adams and York Counties, Pa., will be $3,047,000.

Southern Natural Gas Co., Birmingham, Ala., has permission to construct facilities in Louisiana, Mississippi, Alabama and Georgia to make existing firm customer deliveries during the winter months. Southern will construct 224 miles of 24-in. main loops; 46 miles of 20-in. loops; 40 miles of 14-in. loops, 53 miles of various diameter branch line loops; add 124 horsepower to its compressor capacity, and 2 metering stations at a cost of $28,717,530.

FPC permission was given Pacific Northwest Pipeline Corp., Salt Lake City, Utah, to construct and operate 51.3 miles of 30-in. pipe in Lincoln and Sublette Counties, Wyo. Cost of construction will be $5,542,200.

Distributor appointments

Olin Aluminum, Olin Mathieson Chemical Corp., New York City, Caulley Steel & Supply Co., Fort Lauderdale, Fla.

Alloy Rods Co., York, Pa.: Industrial Welding Supplies Inc., Charleston, S. Carolina.

REDUCE WELDING COSTS
BY PROPER CARE OF
ARC WELDING CIRCUITS
AND REMEMBER

THE WELDERS' CHOICE

HI-AMP®
ELECTRODE HOLDERS

1- Wrap around Glass Fibre Tip Insulation—30% more heat resistant than any other make.
2- Brilliant Red Tips and Trigger-Bright Yellow Handle—all Glass Fibre, an outstanding Safety Feature.
3- Body completely insulated—no bare spots.

Just ask your Welding Supply Dealer for PROOF of the above statements.

LENCO, Inc.
JACKSON, MISSOURI
Weld with HI-AMP

FOR
HARD SURFACING
USE HARD-N-TUFF
The STEEL HARDENING COMPOUND that makes TOOLS and PARTS LAST 300% LONGER!

Used by leading firms for hard-surfacing of gears, taps, dies, and other tools and parts subject to wear.

- Works on any kind of steel, cast iron, or iron-base powdered metals. Makes mild steel outwear tool steel.
- No special equipment needed. Treat tools in your own shop in only 5 to 10 minutes.
- Nitrides, carburizes and chromizes in one simple operation.
- Produces file-hard case with tough inner core.
- Creates no distortion or change in dimensions.
- Safe! Contains no caustic ingredients.

Write for FACT SHEET
showing how easy it is to use HARD-N-TUFF to cut costs and increase production.

CASE HISTORY
Chisel made from ordinary 1020-1/2" drillrod, hardened with HARD-N-TUFF, cut rust-locked nut with 2 hammer blows. Cutting edge was completely undamaged.

HARD-N-TUFF CORPORATION
DEPT. WE, BOX 275, HUNTINGTON, L. I., NEW YORK

PROTECT your acetylene cylinder investment!
Get all the facts about the

ALL NEW COYNE 92
(92% POROSITY FILLER)
ACETYLENE CYLINDER

ALL NEW FILLER
Highest porosity — greatest gas capacity

STRONGER STEEL SHELL
Most durable in the industry

FIELD TESTED FOR YEARS
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PICK UP YOUR PHONE
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200 Paul Ave., San Francisco, Calif.
155 W. Bodley Ave., Memphis, Tenn.
3800 Springdale Ave., Glenview, Ill.
2400 Commerce St., Newark, N.J.

About people . . .

Left to right, Kepner, Mattimore, Wilcoxson.

Linde Co. has named *I. G. Kepner* Pacific Coast manager of distributor and apparatus sales. He will headquarter in San Francisco.

Francis K. McCune, vice president of General Electric Co. and general manager of its Atomic Products Div., has recently been elected president of Atomic Industrial Forum Inc., New York City.

National Cylinder Gas Div., Chicago, has named five new managers of field offices. *H. J. McMurtry* is manager of the new Tyler, Tex., office, *Robert L. Kirkland* is manager of the Shreveport office, *Vernon D. Prater* heads the Augusta office, *Edward D. Whitworth* directs the Charlotte office and *P. J. Chadwick* is Knoxville branch manager.

After 41 years with the Manhattan Rubber Div. of Raybestos-Manhattan Inc., Passaic, N. J., *William H. Steinberg* has retired from his position as sales manager of the Abrasive Wheel Dept.

Tube Turns Div. of Chemetron Corp., New York City, has a new vice president in charge of product engineering and research, *J. D. Mattimore*. He is chairman of the Manufacturers Standardization Society's committee on butt-welding fittings.

Executive committee vice president of the Engineering Foundation—Welding Research Council for the coming three years is *Leslie S. Wilcoxson*, vice president in charge of the Babcock & Wilcox Co. boiler division.

Ed Schwahl is regional representative for welder sales in Utah, Colorado, Arizona and New Mexico for Harnischfeger Corp., Milwaukee. *John Painter*, New York City district manager of the company's Welder Div. is now also in charge of export sales of welders.

G. Barron Mallory has been elected administrative vice president of P. R. Mallory & Co., Inc., Indianapolis. Mallory was practicing law in New York City until now.

Lehmkuhl

Boyer

Barnes

Barnett

Arcair Co., Lancaster, O., has moved three men from its ranks to higher positions. *Elmer Lehmkuhl* is sales manager in charge of marketing and sales in the company's eastern division. *Martin Boyer* is sales promotion and advertising manager, and *Durward B. Vaught* is field representative in Virginia, Kentucky and southern West Virginia.

E. D. Barnes and *H. H. Barnett* have been named application engineers by Wall Colmonoy Corp., Detroit. Barnes will headquarter in Houston and Barnett in Birmingham.

Merritt L. Smith is director of advertising and publicity for Metal & Thermit Corp., New York City.

J. C. Kittle has been named electronics development engineer during a recent reorganization of Whirlpool Corp.'s Clyde Div., Clyde, O. He is a member of the Toledo section of AWS.

John W. Peterson is new field engineer at Norton Co.'s Philadelphia district office.

John P. Poth is manager of the recently established Electronic Controls Section of Budd Co., Philadelphia. He will be responsible for all engineering, manufacturing and sales of Budd-developed control equipment.

Joseph P. Lynch, on the divisional staff of Westinghouse Electric Corp. for two years, is the new advertising and sales promotion manager of the company's Electronic Tube Div., Elmira., N. Y.

Leonard C. Barr has been elected executive vice president of Gregory Industries Inc., Toledo, O. In other moves *George E. Gregory, Jr.*, was elected financial vice president and treasurer, *Richard E. McGinnis* was named vice president—sales, and *Robert J. Kilmer* was named vice president—trade relations.

Weltronic Co., Detroit, has a new general sales manager, *Leonard R. Broniak*. He will head sales of electronic resistance welding controls, arc welders and power devices in all company branch offices.

Chester L. Wells has been named to replace the late *William H. Eisenman* as manager of the American Society for Metals' metal expositions. Wells was assistant to Eisenman.

Broniak

Kliment

William P. Kliment, engineer of standards for the Crane Co., Chicago, has been awarded the American Standards Association Standards Medal for his efforts in the practical development of voluntary standards. Kliment has been active on more than 100 standards committees of various societies, including the American Welding Society.

SOLID

SEMI-AUTOMATIC WIRE

New MANGANAL®

11% - 13½% MANGANESE - NICKEL STEEL

SOLID SEMI-AUTOMATIC WIRE

1. Higher deposition rate. (12 lbs./hr. on high amperage)
2. Higher build-up.
3. Cannot kink and crush in feed rolls.
4. Practically no spatter.
5. 25 lb. coils, 7/64" diameter.

NEAREST DISTRIBUTOR UPON REQUEST

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SOLE PRODUCERS

STULZ-SICKLES CO.

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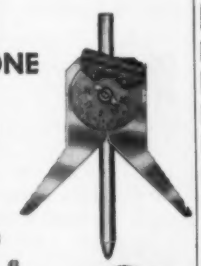
Really FIVE TOOLS in ONE

Yes, actually a BOYCE Centering Head replaces

- ✓ The Protractor
- ✓ The Centerhead
- ✓ The Center Punch
- ✓ The Level
- ✓ The Scale



Determines Center Line at any Degree and Measures Degree of Declivity

Weighs only 9 ozs. Pocket size.

DIAL SET LEVEL

Y type head accurately machined with tangents and tips for centering and aligning. Dial Set Level in graduations of 2½ and 10 degree markings. Punch of Drill Rod with hardened point—insuring long service. Send for complete description.

CONTOUR MARKER CORP.

1843 E. Compton Bl., Compton, Cal.

Also Mfgs. of Contour Markers, Radius Markers and Pipe Flange Aligners.

BOYCE CENTERING HEAD

NEW!

NOW IN 3 CURTAIN MATERIALS:

- ✓ 12 oz. DUCK — fire resistant.
- ✓ NEO-WELD — yellow neoprene-coated fiber glass. Gives greater protection and longer service.
- ✓ ALUMINIZED ASBESTOS CLOTH. Protects by reflection against radiant heat and flame — up to 1400° F.

Light in weight, yet sturdy and rust-proof. Assembles in 5 minutes — no threads. Folds flat. Dozens of uses — welding curtain, machine screen, grinding shield, wall curtain, etc. Available in all sizes. Ask your dealer or write us.

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Complete line of work gloves, welding gloves and safety clothing.

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Over 55,000,000
THERMO FILTER PLATES and COVER LENS
Have Been Sold

WHY?

Because—

- There's a type to insure controlled vision for ANY job!
- Costs less per welding foot than ANY other cover lens.
- Being Precision made and shatterproof they last longer and insure against eye strain.
- For over 15 years THERMO has led in sales and usage.

Ask ANY Welding Supply Dealer or write direct for complete descriptions.

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ORNAMENTAL IRON CASTINGS

MORE THAN 400 DESIGNS for making up ornamental iron grille work, columns, rails. A design for every style of architecture. Complete range of sizes.

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Please send 48-page catalog: "Everything for the Ornamental Iron Shop."

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Yasko

Conklin

Stephen A. Yasko has been appointed vice president, director of sales, for the Berkeley Co., Danville, Ill. He is former manager of sales engineering for Westinghouse Electric Corp.'s Welding Div. and has much experience in gas-shielded metal-arc welding.

Ray B. Conklin, new sales representative for United Specialties Inc., El Dorado, Ark., will cover western New York and northern Pennsylvania from his Buffalo headquarters.

Arcrods Corp., Sparrows Pt., Md., has named *Dr. Gerard E. Claussen* director of research and welding engineering. Claussen was at one time in charge of the Fundamental Research Committee of the Welding Research Council, and served as a metallurgist for Union Carbide and Carbon Corp.

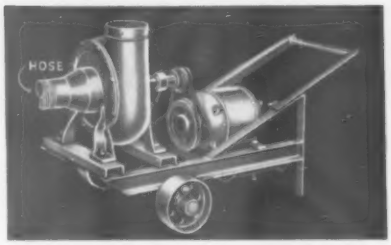
Died . . .

Kenneth D. Bryant, president and founder of Contour Marker Corp., Compton, Calif., died suddenly Friday, Dec. 12. He was 42. Death was attributed to a heart attack. Mr. Bryant is survived by his widow, Gladys, a daughter, Cheryl, and his mother. Mr. Bryant developed the Contour Marker during the early '40's, and began to manufacture and market the device which simplifies pipe layout. At the time of his death he was engaged in experimental work in the rocket and missile field.

Cmdr. Harry Gard Knox died Oct. 29, 1958, at the age of 73. During the first World War, Cmdr. Knox was the U. S. Navy's welding expert, and played an important part in the salvaging of many damaged ships. After the war Cmdr. Knox organized a welding research department at the Norfolk, Va., shipping yard. He later was a naval architect, vice president of Electrical Research Products, a Western Electric Co. subsidiary, and during the second World War he worked with a New York City engineering firm designing floating dry docks.

RUEMELIN *Portable*
Fume Collector

Removes gas, smoke and heat from welding operations. Recommended for ventilation of tank interiors, manholes, vats, airplane fuselages or for blowing fresh air into inaccessible places.



- Collector is equipped with a power unit capable of handling up to 35 ft. of steel tubing. Mounted on rubber tired wheels for ease of handling. Models also available mounted on steel legs for hose operation in a complete 360 degree circle.

- This view shows inlet hood picking up welding smoke. Operator breathing zone protected.

WRITE FOR DETAILED INFORMATION.

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3880 N. Palmer St., Milwaukee 12, Wis. U. S. A.
Manufacturers and Engineers • Sand Blast and Dust Collecting Equipment • Welding Fume Collectors

ANY Pipe Joint or Structural Angle Cut NOW Layed Out in Just MINUTES!

- Marks off easily and accurately any pipe joint.
- Eliminates all figuring of cut backs, and marks all around pipe.
- Saves man-hours, as well as oxygen and acetylene gas.
- Makes it easy to mark off end of lateral pipe.

NO MISTAKES — NO TIME LOSS

—regardless of the type or size of pipe joint to be welded. No more "cut and try" with a **CONTOUR MARKER** — it eliminates the need for calculation, and is available in 2 sizes for marking pipe and structurals of 1½" to 18" in cross section, and from 16" to 48" diameter. Send for complete description.

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1843 E. Compton Bl., Compton, Cal.
Also Mfgrs. of Boyce Centering Heads, Radius Markers and Pipe Flange Aligners.

THE CONTOUR MARKER

ACRO
WELDER MFG. CO.
MILWAUKEE

WELDING ENGINEERS

MACHINERY BUILDERS

ESTABLISHED
1936

30 YEARS AGO

(Taken from the *Welding Engineer* of January, 1929.)

Article tells how welding makes it possible to use aluminum for airplane oil, fuel and water tanks. Aluminum is a desirable material for airplane construction because it is lightweight. However, it was difficult to use until aluminum welding techniques were perfected.

—30 YEARS AGO—

Increased use of oxyacetylene underwater cutting is subject of article by L. F. Hagglund. Method was used on steamship Samaria. Accident caused two blades on manganese bronze propeller to break, unbalancing prop. By cutting other two blades to size of broken blades, prop balance was regained. Cutting was done 20 ft. below surface in freezing water.

—30 YEARS AGO—

Article tells how machinery costs were cut by redesigning a casting of a worm gear elevator to an almost entirely welded steel product.

—30 YEARS AGO—

Included on the program of the recent welding conference at Iowa State College of Agriculture and Engineering, Ames, were W. A. Pearson, Westinghouse Electric & Mfg. Co., and R. L. Lerch, Haynes Stellite Co.

—30 YEARS AGO—

Railroad frogs and crossings of all arc-welded construction are saving money for Havana Electric Railway Co., Cuba. Welding eliminates bolts and rivets and need for castings and forged fish plates.

—30 YEARS AGO—

Three oxyacetylene welded pipelines totaling 4,000 ft. in length are supplying steam to the new Chicago Daily News Building. Two of the welded lines are of 6-in. diameter pipe, the third of 10-in. diameter pipe.

—30 YEARS AGO—

Victor Oxy-Acetylene Co., San Francisco, has changed its name to Victor Welding Equipment Co. The company has also expanded to 14 the number of its distributing and service plants west of the Mississippi River.

When You Weld Cast Iron
Select the Correct
Fuse-Well
CAST IRON WELDING RODS OR ELECTRODES

FUSE-WELL NO. 11
FUSE-WELL No. 11, *Square*—Gray Cast Iron Welding Rod for Acetylene use in filling or building up new or worn castings producing machineable welds.

FUSE-WELL NO. 12
FUSE-WELL No. 12, *Round*—Has the same uses and analytical ingredients as Fuse-Well No. 11.

FUSE-WELL NO. 14 MOLY
FUSE-WELL No. 14, *Moly*—An Iron Base Rod with alloys added for finer grain structure and greater strength.

FUSE-WELL NO. 22
FUSE-WELL No. 22, *Electrode* — Light coated Rod to be used for AC or DC welding in the fabricating and repairing of cast iron castings.

THE CHICAGO HARDWARE FOUNDRY CO.
Weld Rod Division
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WELDORS BUY FROM YOUR DEALER

ASK FOR OUR NEW CATALOG

BRAZILIAN DEERSKIN
THE "STAY SOFT" LEATHER
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Flood Always
FIBER GLASS HELMETS
Seamless and stoutly reinforced with new plastic, ratchet headgear. Easily adjusts to any headsize.

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NEW DESIGN ADVANTAGES
1. Lighter weight.
2. Smoother, easier to clean.
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4. Superior resistance to heat.
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These and other advantages give you better protection, comfort and ECONOMY.

INSTANT HEAD SIZE ADJUSTMENT

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1000-HOUR COVER LENSES
Flood manufactures a complete line of welding and safety equipment . . . if you have a problem feel free to call upon us.

AT YOUR DISTRIBUTOR OR WRITE:

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3035 West Lake Street, Chicago 12, Illinois

free literature . . . . . use card on page 89

51. FLUX DISPENSER—All-State Welding Alloys Co., Inc. Form 41856 details auto-dispenser for Jet-Flux. Sizes, capacity and prices included as is instruction sheet on how Jet-Flux system works.

52. GRINDING WHEELS—Simonds Abrasive Co. Booklet describes depressed center wheels for weld grinding and general use. Pictures and specifications included.

53. HARDENING POWDER—Anti-Borax Compound Co., Inc. Brochure describes Royal Hardening Powder, tells what it can do, size of packages it comes in and gives prices. Powder comes in shaker-can.

54. SPOT WELDERS—Taylor-Winfield Corp. Bulletin 2-013A includes specifications for foot and air-operated machines, the different controls available and their applications.

55. AUTOMATIC WELDERS—Cayuga Machine and Fabricating Co. Automatic circumferential, wheel drum, shuttle index, core lamina and small motor frame welders are detailed in bulletin 5701.

56. SPRAYED COATINGS — Metallizing Engineering Co. Engineering data on wire and powder sprayed coatings of metals and ceramics are given in bulletin 136. Includes pictures.

57. LP-GAS APPLIANCES—Linde Co. Illustrated folder F-1165 describes all new Prest-O-Lite LP-Gas appliances and gives prices.

58. INDUCTION-HEATING—Electric Arc Inc. Expanded applications of low-frequency induction heating system are detailed in brochure entitled "Smith-Dolan system of low-frequency induction heating."

59. CONTROL RELAY — Square-D Co. New line of mechanically held control relays are described in bulletin SM-278.

60. CUT-MACHINING—Wallace Supplies Mfg. Co. Cut-Machining is described in 36 page booklet. Sizes of machine and specifications are included.

61. TANK DRAIN—Squire-Cogswell Co. Automatic electronic tank drain is pictured and detailed in catalog sheet.

62. PROTECTIVE CLOTHING—American Optical Co. Flyer S-7604 tells of Fyre-Free flame-proof cloth and types of apparel made with it.

63. ULTRASONIC GENERATOR—Acoustica Associates Inc. Ultrasonic processing system Model DR-400 A1 is outlined in bulletin DR-400A1.

64. PORTABLE WELDER—Hensley Equipment Co., Inc. Porta-Weld, a semi-automatic welder for hardfacing, is described in company booklet.

65. ULTRASONIC GRINDER—Raytheon Mfg. Co. Product Data 2-332 describes model 2-332 series of ultrasonic impact grinders for machining. Complete specifications and illustrations included.

66. CRYOGENIC CAPABILITIES—Cambridge Corp. Booklet details company's capabilities in the production, storage, transportation and distribution of low-temperature liquids.

67. HYDRAULIC PRESSES—Hannifin Co. Bulletin 130-G describes company's standard line of open gap and column type high-speed hydraulic presses. Contains section of engineering formulas for selecting proper press for a specific application.

68. AIR FURNACE—National Cylinder Gas Div. Use of oxygen in malleable air furnace for refining electric furnace steel and other metals, and two ways in which oxygen improves efficiency, is detailed in Information Report No. 14.

69. SAFETY LINK—E. D. Bullard Co. Low voltage safety link that insulates weldment from hoisting mechanism is described in catalog sheet.

70. WELDING PRODUCTS—International Nickel Co., Inc. Booklet tells of company's welding products, gives electrode requirements for various welded joints, materials for specific applications and government and engineering society specifications for nickel alloys.

71. FLUX CHART—Krembs & Co. Fluxine chart indicates which flux to use for a specific application. Described are company's line of fluxes for various uses.

72. ARC WELDER — Emerson-Electric. Flyer gives important specifications of company's 90-amp, a-c arc welder Model AW 90 SA-166.

73. GRINDERS—Grinding & Polishing Machinery Corp. Bulletin 110 pictures and details abrasive belt Swingframe Grinder for surface cleanup and excess weld removal.

74. FUME EXHAUSTERS—Engwald Corp. Bulletin EN2 includes welding booths and welding fume exhausters. Gives specifications and pictures.

75. ELECTRIC NIBBLERS—Fenway Machine Co., Inc. Four-page flyer gives information on new line of portable air-powered and electric nibblers that cut 10 gage stainless steel and 8 gage mild steel without distortion.

76. SOLDERING FLUXES—American Solder & Flux Co. Bulletin S-567 completely details line of soldering fluxes, tells what applications they are made for and what form they come in.

77. ARC WELDER—Auto Arc-Weld Mfg. Co. Magna Welder, for hardfacing or mild steel welding, is described in booklet. Machine is semiautomatic, feeds tubular and solid wires from a-c/d-c welders.

78. HOSE HOLDER—United Specialties Inc. Weldreel, a unit to hold welding hoses so they are kept out of way, is described in form OA-12.

79. GAS GUN—Velocity Power Tool Co. Torch-O-Matic, an on-off air-acetylene gas gun with trigger action for soldering, brazing, melting and pre-heating is described in bulletin 1413-3.

80. PIPE THAWER — Trindl Products Ltd. Flyer describes Therm-O-Tron, a unit for thawing pipes electronically, but that has attachments for soldering and brazing.

81. WELDING CABLES—Paranite Wire & Cable Div. Brochure gives specifications, pictures of advantages and other details concerning line of welding and power cables.

82. SPATTER PREVENTIVE—Midland Paint & Varnish Co. Engineering information on No-Spat welding fluid is given in six-page booklet. No-Spat is said to prevent spatter from adhering to metal and to increase tensile strength.

83. POWER SUPPLY—Robert W. Hoffman Co., Inc. Synchro-Power, an a-c bench welder power supply, is described in pamphlet.

84. SOLDERING FLUX—Ruby Chemical Co. Flyer details company's acid core solder, stainless steel flux, soldering and tinning flux and soldering paste.

85. X-RAY APPARATUS—Mitchell Radiation Products Corp. Flyer includes specifications, technical data, pictures and description of Isovolt 300 industrial X-ray equipment.

86. IRON WORKER—Bateman Foundry & Machine Co. Flyer details Bantam Iron Worker. Specifications are given, machine is pictured in action and diagrams of blades, angles and channels available are shown. Prices are included for all parts.

111. AUTOMATIC WELDING—Dix Engineering Co., Inc. Brochure on automatic welding machines cites solutions to production problems.

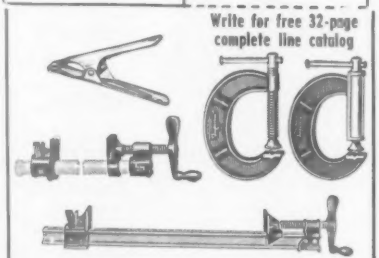
112. ROTARY TOOLS—Allegheny Ludlum Steel Corp. Solid carbide rotary tools are treated in bulletin (volume 1, No. 10).

113. NUCLEAR SYSTEMS—Ford Instrument Corp. Nuclear systems and controls are listed on page.

114. ZIRCONIUM—U. S. Industrial Chemical Co. Handsome booklet discusses zirconium and hafnium. Includes graphs, other technical data.

WHERE TO BUY

"Jorgensen" and "Pony" CLAMPS



Sold through leading distributors

Adjustable Clamp Co.

"the clamp folks"

426 N. Ashland Ave. Chicago 22, Ill.

CLASSIFIED EMPLOYMENT • BUSINESS • OPPORTUNITIES

THE WELDING SHOPPER

ADVERTISING • EQUIPMENT—USED and RESALE

UNDISPLAYED RATE

(Not available for equipment advertising)
1.10 a line, minimum 6 lines. To figure advance payment, count 5 average words as a line.

INDIVIDUAL EMPLOYMENT WANTED advertising rate is ½ the above rate; minimum $5, payable in advance.

DISPLAYED RATE

The advertising rate is $12.00 per inch for all advertising appearing on other than a contract basis. Maximum size of display ad is 4 col. in. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ in. vertically on one column, 3 columns—30 inches—to a page.

HELP WANTED

SALESMEN WANTED: Prominent gas manufacturer has immediate openings in metropolitan New York area for experienced men with gas or equipment sales background. Salary, expenses, benefits, good territories, and unlimited opportunity. Reply in detail to box 138, c/o Welding Engineer, 5826 Dempster, Morton Grove, Ill.

SUPERINTENDENT

To manage shop for structural steel fabricator and vessel builder in East. Must know metal fabricating, machining and all kinds of welding processes. Engineering training preferred. Requires energetic person with leadership ability and cost consciousness. Employs 150 shopmen. Unusual opportunity—salary open. Send résumé to

Box 139, c/o Welding Engineer
5826 Dempster St., Morton Grove, Ill.

SALES MANAGER

Mechanical background, welding experience preferred. Responsible for expanding and developing national sales group for manufacturer of special production resistance welding equipment. Should have previous successful sales management experience. One of the large manufacturers of this type of equipment located in Michigan.

MANAGER SALES ENGINEERING

Same location supervise group responsible for sales quotations, sketches, specifications for special production resistance welding equipment. Should have mechanical background with resistance welding experience.

Write Box No. 140,
C/O Welding Engineer, 5826 Dempster St.,
Morton Grove, Ill.

WELDING ENGINEER

Development of methods for welding, brazing and other similar methods of joining NEW AND DIFFERENT materials to themselves and to each other

Development of techniques for fabrication of SPECIAL AND UNUSUAL materials

B.S. in Welding Engineering; Mechanical, Metallurgical Engineering, or Metallurgy with interest in welding and 1-5 years experience

Employee benefits, educational assistance, family relocation expenses. Homes and apartments in a variety of settings. Excellent school systems

Send resumé or letter of interest to

CENTRAL EMPLOYMENT OFFICE
Technical Personnel
UNION CARBIDE NUCLEAR COMPANY
a Division of
UNION CARBIDE CORPORATION
Post Office Box P, Oak Ridge, Tennessee

WANTED TO BUY

WANTED

Good used 244 Cu.Ft. Oxygen Cylinders. State quantity and price. Write Box No. 137 C/O Welding Engineer, 5826 Dempster, Morton Grove, Ill.

EQUIPMENT FOR SALE

500 — 200 Cu. Ft. Oxygen Cylinders complete with valves
Entire lot or quantity you want.
A. BAEYEN
447 Greeley Ave.
Webster Groves 19, Mo.

METALLIZING WIRES
Rigidly Specified For
METAL SPRAYING
Spra Rod CORPORATION
2795 East 83rd St. • Cleveland, Ohio • LOngacre 1-7168

CHECK YOUR LOG TABLES
A new angle on pipe layout. With one move on new simple slide rule, read both length of pipe and angle of cut for "dog leg," braces, trusses, etc.
Prepaid $3.50 each
BIG MIDGET PRODUCTS
Dept. 1A 2221 8th St., Lubbock, Texas

HEAVY DUTY TURNING ROLLS
for rotating pressure vessels, pipe and cylindrical bodies for welding
Aronson MACHINE CO., ARCADE, N. Y.
A COMPLETE LINE of WELDING POSITIONERS

2,000 lbs Stainless Steel 18/8 CB Gas Rod 1/8" x 36"
(50 lb. Bndls)
Very Reasonable
LEHMAN METALS
700 E. 133rd St., New York 54, N. Y.

2—125 LB. SIGHT FEED ACETYLENE GENERATORS MODEL 125A

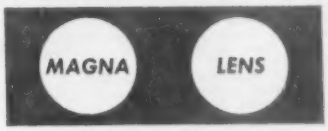
Still in original shipping crates, never used. Submit a reasonable offer.

SCRANTON BATTERY CORP.
ARCHBALD, PENNSYLVANIA
Phone — Jermyn 2

SCHOOL

WELDING—A profitable trade. Demand for trained men. Learn quickly at best equipped school in U. S. Non-profit. G. I. approved. Catalog free. Write: Hobart Welding School, Box U-19°, Troy, Ohio.

EQUIPMENT FOR SALE

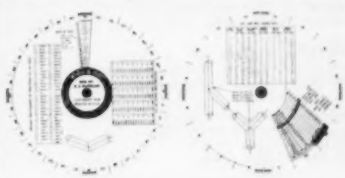


Holds Professionally Prescribed lens in welders helmet —eliminates need for glasses.

Ask Your Vision Specialists

THE MAGNA COMPANY
Holdenville, Oklahoma

CUTTING MACHINES, AIRCO Camo & Radiagraphs and NATIONAL No. 5.
SEAM WELDER, Progressive, 150 KVA, New.
SPOT WELDER, National, 40 KVA, Used.
CUTTING TORCHES, Used, Oxweld, Airco, Harris.
WELDING TORCHES, New, Rego GV.
BRONZE—STAINLESS—AMPCOTRODES.
ELECTRODE HOLDERS.
RALL SUPPLY CO. 51 E. 42nd St., N.Y.C. 17



DIAL-A-CUT

Prefected "Dial" calculator 5½ inches in diameter. Consisting of instant calculations of the cut back of miter, saddle and "y" cuts on pipe sizes 2 inch to 48 inch. Designed to save both time and accuracy.

Guaranteed Accurate.....Price $3.00

R. E. McMillan
P.O. Box 1532
Savannah, Georgia

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This advertisers' index is included as a convenience and is in no way a part of the advertising contract. Although every care has been taken to index accurately, some errors may have occurred and no allowance will be made for them.

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125. Acro Welder Mfg. Co.—Write for further information on welding machinery, engineered and manufactured to order.

126. Adjustable Clamp Co.—Catalog on complete line of "Jorgensen" and "Pony" clamps available.

127. Airline Welding and Engineering—Complete information available on "Airline Longitudinal Welding Positioners" and accessory equipment.

128. Air Reduction Sales Co.—Write for information on Airco's "Easyarc" stainless steel electrodes in the aluminum "Pop" cans.

129. Alloy Rods Co.—Bulletin AR-10-2 on "Arcaloy" stainless steel electrodes available.

130. Alloy Rods Co.—Bulletin HS-102 on the "Wear-O-Matic" process can help you with maintenance operations in your industry.

131. All-State Welding Alloys Co.—Instruction manual covering the whole line of All-State equipment available.

132. Alva Allen Industries—Catalog giving complete information, specifications and prices on Allen's heavy duty punch presses.

133. American Brass Co.—Further information available on "Everdur" a high strength corrosion resistant alloy made basically of copper and silicon.

134. American Optical Co.—Literature on AO's weld-cool helmet available.

135. American Platinum & Silver Div.—Two complete reference manuals for low temperature silver brazing and fluxing are available.

136. Ampco Metal, Inc.—Information on "Ampco-Trode 10" electrodes and filler rods.

137. Ansco X-Ray—Write for further information on Ansco's x-ray films.

138. Arcair Co.—Information available on Arcair Torches and special electrodes.

139. Aronson Machine Co.—Detailed engineering data available on Aronson's positioners.

140. Aro Spot Welder Div.—Illustrated literature on spot welders for every job.

141. Atlantic Abrasive Corp.—Catalog on grinding wheels available.

142. Atlas Welding Accessories Inc.—Further information available on the Atlas line of weld cleaning tools.

143. Chicago Hardware Foundry Co.—Information on "Fuse-Well" cast-iron welding rods and electrodes available.

144. Contour Marker Corp.—Information and instruction book on laying out pipe joints.

145. Contour Marker Corp.—Details on establishing and marking a point at any angle.

146. Coyne Cylinder Co.—Write for details on Coyne acetylene cylinders.

147. Electric Arc, Inc.—Write for copy of new brochure, "Smith-Dolan System of Low-Frequency Induction Heating."

148. Fibre-Metal Products Co.—Data available on "SuperLite" aluminum safety caps and other safety equipment.

192. Flood Safety Products Co.—Information available on fiber glass helmets manufactured by Flood and other welding and safety equipment.

149. Goldsmith Brothers Smelting & Refining Co.—For complete information on low temperature silver brazing write for a copy of the GB data book.

150. H & M Pipe Beveling Machine Co.—Illustrated catalog sheets on the new models of the H & M Shape Cutter and Out-of-Round attachments.

151. Handy & Harman—Bulletin 20 gives information on silver brazing and its benefits.

152. Hard-N-Tuff Corp.—Write for "Fact Sheet" showing how to use Hard-N-Tuff.

153. Harnischfeger Corp.—Further information available on the P & H combination AC-DC welders.

154. Harrisburg Steel Co.—Information on gas cylinders manufactured by Harrisburg.

155. Hobart Brothers Co.—Write for more information on Hobart Arc Welders.

156. Hobart Brothers—Electrode catalog, arc welder catalog and welding accessories catalog all available, also samples of "Rocket 24" iron powder electrodes.

157. Independent Engineering Co.—Information available on transporting gases by gas supply trailers.

158. International Nickel Co.—Booklet, "A Handy Guide To Welding Cast Iron" covers the use of Ni-Rod "55."

159. Jackson Products—Further information on arc welding helmets.

160. Lenco, Inc.—Data on Lenco's "Hi-Amp" electrode holders.

161. Lincoln Electric Co.—Information on the "Mechanized Squirt Welder."

162. Lincoln Electric Co.—Bulletin SB-1337 on the Lincoln Engin-Driven welder available.

163. Linde Co.—Write for further information on the new "Sigma ST-2" hand welding torch.

164. Linde Co.—Catalog F-4487 available on "Oxweld" portable cutting machines.

165. Linde Co.—Write for the name and address of your nearest Linde supplier, where you can purchase the "Oxweld" goggles and gloves.

166. P. R. Mallory & Co., Inc.—Chart "Do's and Don'ts for resistance welding" available.

167. Manhattan Rubber Div.—Further information on Manhattan's reinforced cut-off wheels.

168. Merrill Brothers—Information on material handling devices available.

169. Messer Cutting Machines, Inc.—Write for further information on Messer's line of precision cutting machines.

170. Metal & Thermit Corp.—Write for helpful hard surfacing data on convenient 3"x 5" file cards.

171. Miller Electric Mfg. Co. Inc.—Further information available on the Miller "Gold Star SR" DC welder.

172. Miller Electric Mfg. Co. Inc.—Information on Model SRH and Model SR also available.

173. National Carbide Co.—Information on calcium carbide and name of nearest distributer.

(Continued on page 90)

WELDING INFO-AIDS

USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

NEW PRODUCTS described on pages 66 to 74

Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

USE POSTPAID CARD →

★ For copies of any manufacturers' bulletins described on these pages, circle the number of the items on card at right. Fill in your name, title, company and address. This has to be done only once on either post card. You need no postage.

★ For additional information on New Products described in this issue, circle the numbers of the items that interest you. The New Products section begins on page 66.

WARNING!

Illegible or incomplete addresses may keep you from receiving the information you desire. And remember, cards postmarked after the deadline date cannot be processed.

★Post card not valid after three (3) months. After that, write *directly to the manufacturer*, describing fully the information and/or literature wanted.

Name_____ Title_____

Company_____

Address_____

City_____ State_____ 1/59

NOT GOOD AFTER APRIL 1, 1959

WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill.

Please send me without obligation further information about the following:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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BUSINESS REPLY CARD

First Class Permit No. 32, Morton Grove, Ill.

Welding Info-Aids,
Welding Engineer
P.O. Box 28
Morton Grove, Ill.

Literature offered in ads

(Continued from page 88)

174. National Electric Welding Machines Co.—Complete information on developing a welding machine for your specific problem.

175. National Welding Equipment Co.—Catalog Form 14 gives data on cylinder manifolds.

176. Page Steel & Wire Div.—A welding wire packaging chart and comparison chart is available.

177. Phoenix Products Co.—Literature on the latest rod-drying methods, "Dry Rod as Standard Welding Equipment."

178. Picker X-Ray Corp.—Information on new roving units for on the job isotope radiography.

179. Rankin Mfg. Co.—Ran-Check-Charts and Stickers available to promote regular inspection of equipment parts.

180. Ruemelin Mfg. Co.—Write for detailed information on Ruemelin portable fume collector.

181. Singer Glove Mfg. Co.—Catalog on Singer's complete line of work gloves and safety clothing.

182. Square D Co.—Bulletin 8991 on Industrial plug-in timers and relays.

183. Stulz-Sickles Co.—Information on "Manganal" semi-automatic wire and list of nearest distributor available.

184. Sylvania Electric Products Inc.—Information on color coded Sylvania Tungsten electrodes.

185. Tempil Corp.—Write for further information on "Tempilstiks" and booklet "How Temperatures Are Measured."

186. Tennessee Fabricating Co.—"Everything for the Ornamental Iron Shop," 48 page catalog available.

187. Thermacote Co.—Write for complete descriptions of "Thermo" filter plates and cover lens.

188. Tillman & Co., John—Write for catalog on weldor's gloves and garments.

189. Tuffaloy Dept., Air Reduction Sales Co.—Catalog and prices on Tuffaloy spot welding tips, tip holders and adapters.

190. Victor Equipment Co.—Further information available on Victor's cutting equipment and regulators.

191. Welsh Mfg. Co.—Write for further information on eye shields for weldors.

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BUSINESS REPLY CARD
First Class Permit No. 32, Morton Grove, Ill.

Welding Info-Aids,
Welding Engineer
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Morton Grove, Ill.

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★ Post card not valid after three (3) months. After that, write *directly to the manufacturer*, describing fully the information and/or literature wanted.

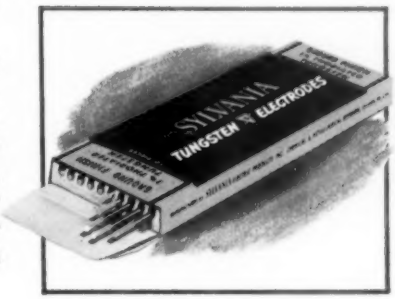
Opinions vary on the preferred finish but–

most welders agree on the preferred electrode

WHETHER your personal choice is in the cleaned finish or the ground finish, Sylvania makes it available to you through your favorite welding supply distributor.

And your choice is available on all four electrode types: Puretung®, Zirtung®, 2% Thoriated, and 1% Thoriated. Whichever finish, in whatever type you choose, it makes good sense to use Sylvania.

Easiest to use—easiest to get—widest range of applications, these are just a few of the important reasons why more welders use Sylvania Tungsten electrodes than any other brand. Ask your Distributor for Sylvania next time you order electrodes.

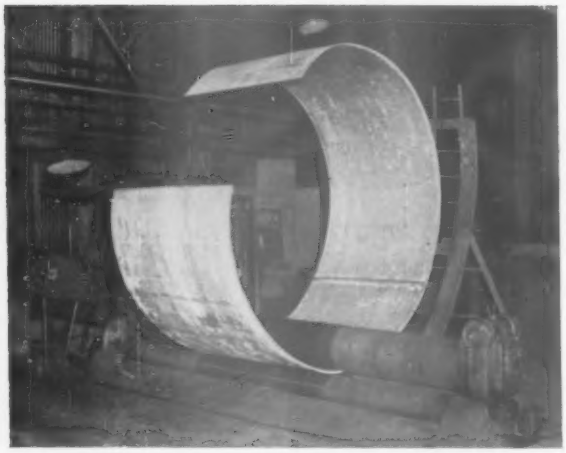


SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
Chemical & Metallurgical Div.
Towanda, Penna.

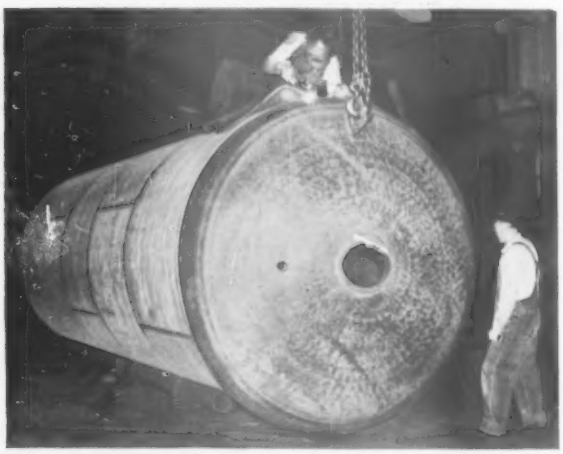
TUNGSTEN · MOLYBDENUM · CHEMICALS · PHOSPHORS · SEMICONDUCTORS

Tanks, heat exchangers and processing equipment for tough jobs are fabricated quickly and easily of corrosion-resistant Everdur®



At Old Dominion Iron and Steel Corporation, Belle Isle, Richmond, Virginia, *(O.D.I.S.), fabricators of tanks, heat exchange equipment and pressure vessels,* two plates of Everdur-1010 (151″ x 56$\frac{5}{16}$″ x .513″), previously welded together, are rolled to form a cylindrical tank section.

When rolling is completed the beveled edges of the plates are butted to form a vee groove which then will be welded to complete the section. Five such sections will be put together by *Old Dominion Iron & Steel Corporation* to make the 26′-9″ shell of the storage heater.



The storage heater is completed by attachment of two flanged and dished heads 96″ outside diameter. The heads were press-formed and spun by *Old Dominion Iron and Steel Corporation* from circles of Everdur-1010, 104″ in diameter and .674″ thick.

The completed 10,000-gallon storage heater has 196 feet of welds. All welding was done with the inert-gas tungsten-arc using Everdur-1010 Welding Rod, which makes welds that meet ASME Boiler and Pressure Vessel Code requirements for soundness, strength, ductility.

EVERDUR-1010 provides the high strength and excellent corrosion resistance needed for all kinds of hot-water storage tanks and for pressure vessels and equipment used in the chemical and processing industries. This tank will be used for hot-water storage in a wool-dyeing plant.

High-strength, corrosion-resistant alloys, basically copper and silicon, are made and sold by The American Brass Company under its trade-mark, Everdur. They were developed for structural and engineering uses which require metals of high tensile strength combined with immunity to rusting, and corrosion resistance equivalent to that of copper. Everdur alloys are nonmagnetic, highly resistant to fatigue, and, depending on the alloy, suited to hot or cold working and economical fabrication by welding. 58107A

EVERDUR®

COPPER-SILICON ALLOYS

Products of

ANACONDA®

Made by The American Brass Company